

## F. Analysis of applied R&D projects results

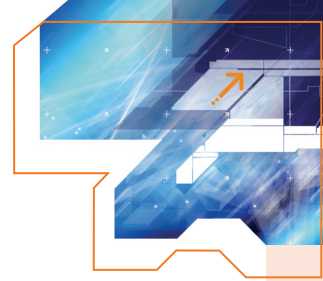
### F 1. Projects of applied research completed between 1998 and 2001

(number of projects and number of encompassing programmes)

	1998	1999	2000	2001	Total
<b>Ministry of Defence</b>					
number of completed projects	54	50	84	89	277
number of programmes	4	4	4	2	
<b>Ministry of Industry and Trade</b>					
number of completed projects	75	125	84	89	472
number of programmes	7	8	4	2	
<b>Ministry of Health</b>					
number of completed projects	310	287	237	127	961
number of programmes	13	15	14	14	
<b>Ministry of Agriculture</b>					
number of completed projects	55	75	16	85	378
number of programmes	4	2	35	5	
<b>Ministry of Environment</b>					
number of completed projects	20	22	16	21	79
number of programmes	9	10	10	11	
<b>TOTAL</b>					
<b>number of completed projects</b>	<b>514</b>	<b>559</b>	<b>638</b>	<b>456</b>	<b>2 167</b>

Source: Materials prepared by the relevant ministries in an agreed-upon format

Note: "Number of programmes" indicates the number of programmes within which the relevant projects were completed.



## F 2. Projected utilisation of results of applied R&D projects completed between 1998 and 2001

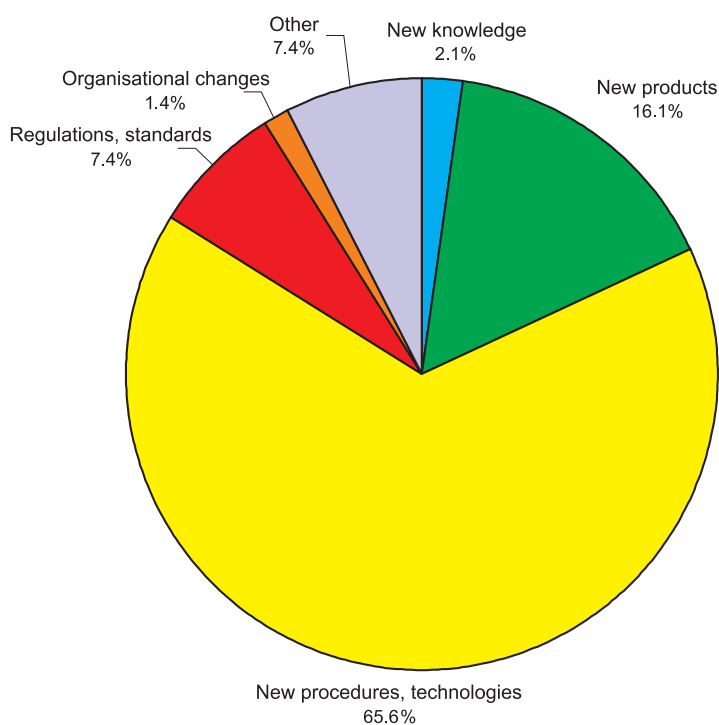
(number of expected utilisations of projects results)

	MO	MPO	MZd	MZe	MŽP	Total
All completed projects	277	472	961	378	79	2 167
<b>Projected methods of utilisation</b>						
New knowledge without specific concept of utilisation	26	0	0	22	0	48
New products	41	273	0	62	–	376
New procedures, technologies etc.	103	164	916	312	35	1 530
Regulations, standards	20	9	45	72	26	172
Organisational changes	26	–	–	6	–	32
Other	61	26	–	67	18	172
<b>Total utilised results</b>	<b>277</b>	<b>472</b>	<b>961</b>	<b>541</b>	<b>79</b>	<b>2 330</b>

Source: Materials prepared by relevant ministries in an agreed-upon format

Note: MO – Ministry of Defence; MPO – Ministry of Industry and Trade; MZd – Ministry of Health; MZe – Ministry of Agriculture; MŽP – Ministry of Environment.

Graf F 2. – Projected methods of results utilisation



### F 3. Actual utilisation of results of applied R&D projects completed between 1998 and 2001

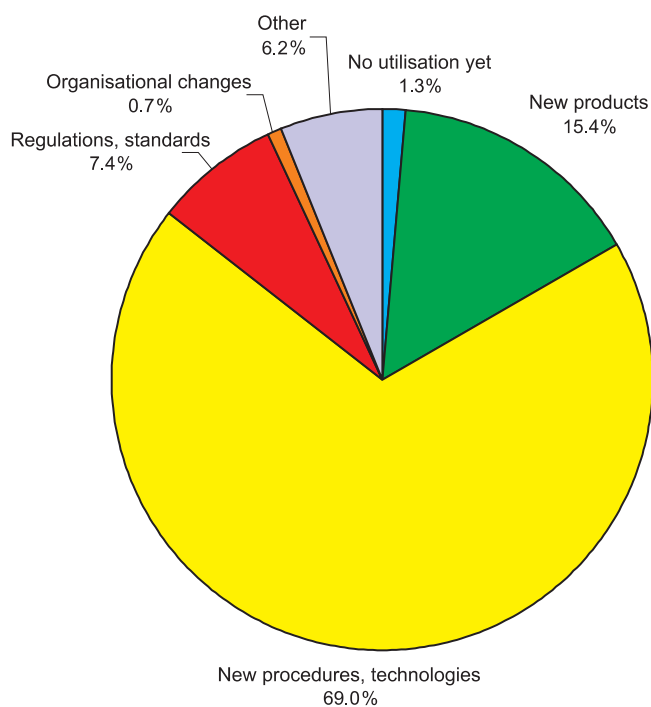
(number of of actual utilisations of project results)

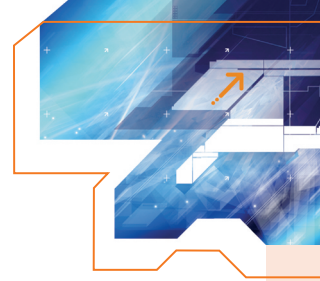
	MO	MPO	MZd	MZe	MŽP	Total
All completed projects	277	472	961	378	79	2 167
<b>Actual modes of utilisation</b>						
No utilisation yet	14	0	0	13	0	27
New products	9	254	0	50	–	313
New procedures, technologies etc.	36	152	915	263	35/39	1 401/1 405
Regulations, standard	4	9	45	67	25/28	150/153
Organisational changes	9	0	–	6	–	15
Other	21	26	–	61	18/19	126/127
<b>Total utilised results</b>	<b>93</b>	<b>441</b>	<b>960</b>	<b>460</b>	<b>78/86</b>	<b>2 032/2 040</b>

Source: Materials prepared by relevant ministries in an agreed-upon format

Note: More than one mode of utilisation of results may be envisaged for a completed project. The sum of utilisation modes may thus exceed the number of completed projects. MO – Ministry of Defence; MPO – Ministry of Industry and Trade; MZd – Ministry of Health; MZe – Ministry of Agriculture; MŽP – Ministry of Environment.

Graf F 3. – Actual modes of utilisation of projects





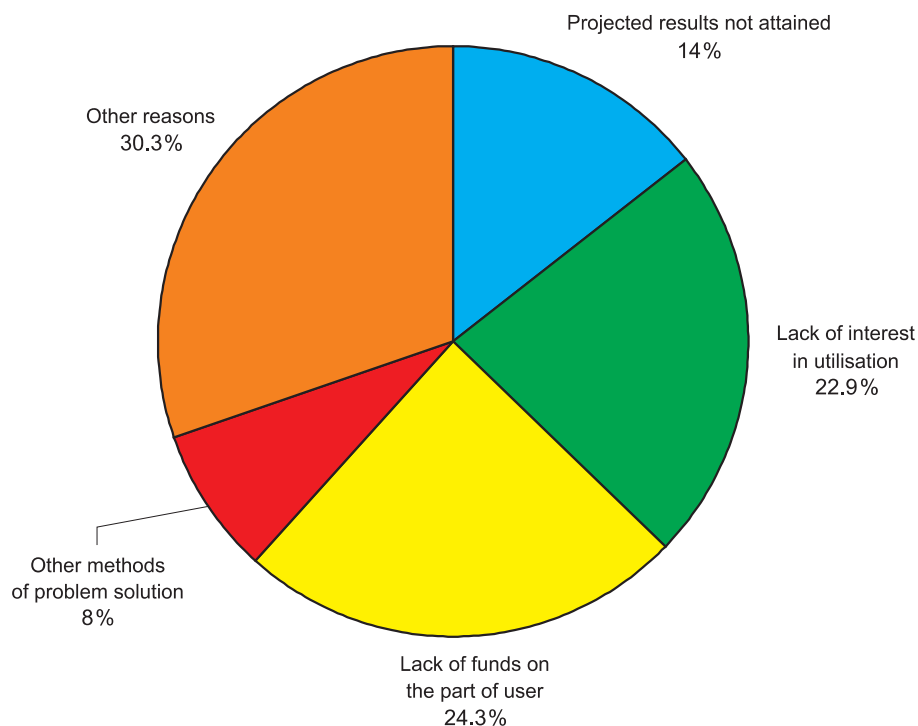
#### F 4. Reasons underlying the difference between projected and actual utilisation of applied R&D projects completed between 1998 and 2001

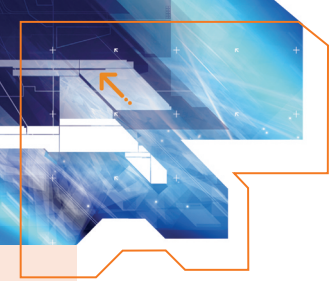
	MO	MPO	MZd	MZe	MŽP	Total
All completed projects	277	472	961	378	79	1 206
<b>Reasons underlying difference in utilisation</b>						
Projected results not attained	21	3	0	6	–	30
Lack of interest in utilisation	27	9	0	10	–	46
Lack of funds on the part of user	22	12	1	17	–	52
Other solution of problem identified	11	2	–	4	–	17
Other	12	5	–	46	1	64
<b>Total</b>	<b>93</b>	<b>31</b>	<b>1</b>	<b>83</b>	<b>1</b>	<b>209</b>

Source: Materials prepared by relevant ministries in an agreed-upon format

Note: MO – Ministry of Defence; MPO – Ministry of Industry and Trade; MZd – Ministry of Health; MZe – Ministry of Agriculture; MŽP – Ministry of Environment.

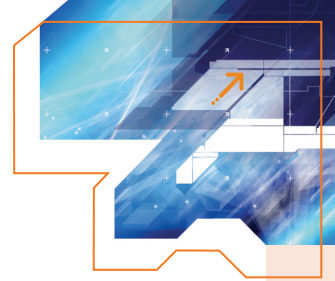
Graf F 4. – Reasons for difference in utilisation





## Commentary

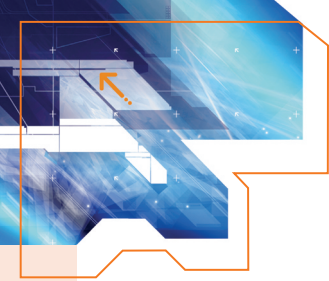
1. The analysis dealt with R&D projects of those resorts where support focuses on practical utilisation of the obtained results, i.e. Ministry of Industry and Trade, Ministry of Agriculture, Ministry of Defence, Ministry of Environment and Ministry of Health. The assessment was made on the basis of requested materials prepared in an agreed-upon format. The manner of their assessment is equal to the assessment made in the framework of R&D analysis in 1999.
2. Most completed projects belong to the Ministry of Health (more than 44 % of the total number of completed projects). These are particularly minor projects. The second in the succession is the Ministry of Industry and Trade (almost 22 % of the total number of completed projects). Comparing with the results of 1999 analysis it is possible to state that in the defence, industry and trade and agriculture resorts the number of programmes was increased accompanied by the corresponding growth of the volume of projects. In the Ministry of Environment and Ministry of Health the specific support continues to be provided to a large number of smaller projects.
3. In all resorts except research supported from the Ministry of Industry and Trade budget new procedure or technology are the most frequent envisaged form of utilisation of applied R&D results. In total, this form of the envisaged utilisation represents 65 % of all utilisation. The Ministry of Industry and Trade reports a new product to be the most frequent form of R&D results utilisation. In the resort of the Ministry of Health new procedures prevail. In the resort of the Ministry of Environment the share of projects of normative or methodological character is substantial, although not prevailing. This research is an important part of R&D also in the resort of agriculture. Although the data in part F 2 do not refer to the basic research, in the sphere of the Ministry of Defence and Ministry of Agriculture there is a substantial share of those results which represent new knowledge without specific utilisation. With a view to the utilisation, not investigative character of the mentioned resort R&D support it is possible to assume that this share of results represents rather a side-effect of the utilisation of research and development activity.
4. New procedures and technologies also represent the most frequent form of the actual utilisation of applied R&D results. Out of the envisaged number of new procedures and technologies more than 80 % are generally fulfilled. New products follow afterwards where this form of utilisation of R&D prevails in the Ministry of Defence as well as in the envisaged utilisation. In total, 87 % of envisaged results of applied R&D projects were fulfilled. This result is influenced by the fact that in the resort of the Ministry of Health the envisaged results were fulfilled for almost 100 %.
5. Between 1998 and 2001 the differences between the envisaged and actual utilisation of results were found with respect to 208 applied R&D projects. The largest number of those projects are found in the resort of the Ministry of Defence. In total, it was 93 projects which represents almost 45 % of all applied R&D projects of assessed resorts where the envisaged results were not attained. For specific reasons the most frequent reason is the lack of interest in utilisation.
6. The results of analysis in 1999 when almost 100 % of envisaged results were attained were unusual in the world scope. They either certified the modest aims of applied R&D projects or shortcomings in the assessment of results. The results of the envisaged assessment of completed projects of applied R&D slowly begin to reach the foreign level.



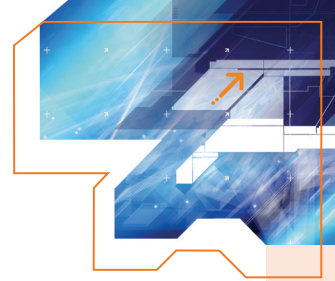
## F 5. Examples of extraordinarily successful results of R&D projects in the Czech Republic

Mostly the results of applied research and industrial development are mentioned in the Table as they can be easily specified. In the basic research, usually publications are the outcomes. The publication is a matter of a longer period of time. We included mostly the projects completed in recent years

Provider	Organisation	Output	Description of output, benefits
Academy of Sciences of the CR	Institute of Microbiology of the Academy of Sciences	Modern biotechnology in environment protection. Tests on biological toxicity of polychlorinated biphenyls and other organic pollutants.	Verified tests are more sensitive than the tests of leaches of contaminated earths, so far legislatively accepted. They shall facilitate to better assess ecological risks and effectiveness of sanative procedures. The results are commercially used by ENVISAN Gem, s.r.o.
Academy of Sciences of the CR	Institute of Chemical Technology of the Academy of Sciences	New technology of glass melting based on the utilisation of microwave energy.	In 2001 the centre of microwave technology was established. The results of tests in the glassworks have proved the influence of microwaves on the quality of glass. It is an energy-saving and ecologically friendly technology which is protected by a patent both in the CR and abroad. This Czech technology facilitated the sale of licences.
Academy of Sciences of the CR	Institute of Analytical Chemistry of the Academy of Sciences in co-operation with the Institute of Pathological Physiology of the Masaryk University in Brno	Ultra-speed diagnostic method for the stipulation of mutations and polymorphisms of DNA genom. New method applicable for molecular diagnostics of serious hereditary diseases.	New method is much faster and less expensive than the older methods. Fully automated method may be more easily applicable in clinical practice.
Academy of Sciences of the CR	Institute of History of Art of the Academy of Sciences of the CR	Rudolf II and Prague: Imperial court and residential town.	A lot of actions and publications. Culmination by an exhibition and international conference in 1997.
Academy of Sciences of the CR	Institute of Plasma Physics in co-operation with the 1 <sup>st</sup> Internal Clinic of the General Faculty Hospital	Development of a generator of focused pulse waves with a heavy-current spark discharge. Apparatus for non-operational removal of calculi from the bodies of the patients, particularly of kidney stones.	The stones are crushed by the pulse wave and are removed from the body in a natural manner. The apparatus was made by MEDIPO s.r.o. and already 16 hospitals are equipped with it.

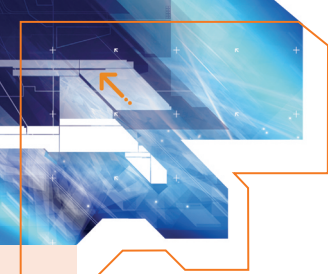


Provider	Organisation	Output	Description of output, benefits
Academy of Sciences of the CR	Institute of Organic Chemistry and Biochemistry of the Academy of Sciences of the CR	New purine acyclic aperiodic nucleocidphosphates with anti-virus and anti-neoplastic effects.	Developed drug forms two of which were approved for the use in the USA and some European countries (Vistide with anti DNA viruses effect and Viread for the AIDS therapy – licence outcome is so far CZK 208 mil.).
Ministry of Defence	ERA, joint stock company Pardubice	Passive monitoring systems. Development of equipment for the detection of radio and radio-technical signals.	The equipment enables to analyse received signals and specify the type of object. The development of passive monitoring system VĚRA was launched. Producer ERA a.s. Pardubice.
Ministry of Defence	Military Technical Institute of Defence Brno (with co-operating organisations)	Laboratory sample for the indication of bacteria simulating the presence of war biological means in the air on the biosensoric principle.	Laboratory sample of apparatus for the identification of viruses and bacteria was developed. Experiments yield good results.
Ministry of Industry and Trade	MEGA, joint stock company	Centre of development and production of ionex membranes and progressive membrane technologies for power engineering, industry and environment protection	Development of new and modified membranes with industrial application of membrane technologies, e.g. of electro-dialysis and electro-phoresis. Utilisation in the liquidation of environmental hazards and in recuperation and purification of precious metals.
Ministry of Industry and Trade	SIGMA, Research and Development Institute, Ltd.	Development and production of mobile filling stations.	Mobile pumping station driven by diesel motor of a great capacity was developed. It is capable to pump up to 670 l/sec. The stations were used several times for the disposal of flood consequences.
Ministry of Industry and Trade	ŠKODA Research, Ltd.	Elaboration of methodology for the optimisation of construction of transport means from the point of view of their reliability, safety and service life.	Methodology examined in practice and used e.g. in the development of trolley-buses ŠKODA Ostrov and tracked vehicles in ŠKODA Dopravní technika.
Ministry of Industry and Trade	Vítkovice – Research and Development, Ltd., Ostrava	Materials for modern equipment for extraction of oil from the sea floor.	The results facilitate the production of plates, castings and forgings of a top quality, conforming the strict requirements of consumers from the Scandinavian countries. In 2001 the products of the total price of CZK 30 mil. were made.

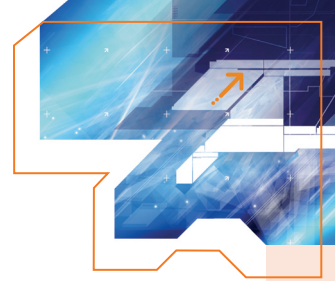


Provider	Organisation	Output	Description of output, benefits
Ministry of Industry and Trade	Research Institute of Organic Syntheses, joint stock company, Pardubice Rybitví	Insecticides of the 4 <sup>th</sup> generation, research and development of the technology of chirally pure juvenoid (S-Mtp).	Produced product was for application tests which were executed by partner from the USA. It was put into market.
Ministry of Industry and Trade	Research Institute of Textile Machines, joint stock company, Liberec	Highly efficient weaving hydraulic machines of WL type. Up to the phase of prototypes all fundamental groups of the weaving machines are solved.	The machine parts have peak parameters and facilitate to attain 1 700 rev/min. Prototype of a machine comparable to the world top machines was constructed.
Ministry of Education, Youth and Sport	Association of legal entities CESNET	Implementation of TEN34 CZ network	Creation and putting into operation of the national research and development communication and hi-speed network. The project was followed by a number of application projects.
Ministry of Education, Youth and Sport	Czech Egyptology Institute of the Philosophical Faculty of the Charles University and Czech Egyptology Centre	Discovery of a crypt and shaft tomb	Discovery of a tomb of the judge and priest Inti from the beginning of the 6 <sup>th</sup> dynasty and discovery of intact shaft tomb of the administrator of palaces Infa from the beginning of the Persian time in Egypt. Extraordinary reaction abroad.
Ministry of Education, Youth and Sport	Czech Technical University in Prague	New type of total knee substitution with the use of bio-ceramics.	New knee substitute using bio-ceramic material in femoral component. Its envisaged service life is longer than in case of metal substitutes.
Ministry of Education, Youth and Sport	Library of the Academy of Sciences of the CR	Web of knowledge	The most important world-wide source of information on science divided pursuant to the branches, workplaces and workers. Multilicence facilitates the access to the database in the whole territory of the CR.
Ministry of Education, Youth and Sport	Vitkovice – Research and Development, Ltd. Ostrava	New methods of extraction of magnetite, zinc and lead from metallurgical dusts and sludges.	Development of new methods of utilisation of metal-bearing wastes with the extraction of pure Zn and Pb for the industrial use and of magnetite in the quality necessary to the purification of sewage water.
Ministry of Education, Youth and Sport	Institute of Chemical Technology, Prague	Improvement of utility properties and intensification of titan white production.	Produces Precheza, a.s. Přerov. The preparation of modified calcinates for the improvement of optic parameters of titan white solved. 5 patents and 2 patent applications registered.

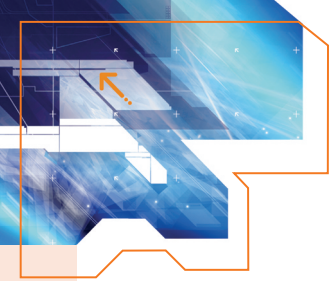




Provider	Organisation	Output	Description of output, benefits
Ministry of Education, Youth and Sport	West-Bohemian University, Plzeň	Mathematical and computer modelling of urethra.	Conception of the analysis of properties of real models of urine tract. Simulation of physiological activity of urine tract, of influence of pathological actions on its function and of examination methods used in clinical practice.
Ministry of Education, Youth and Sport, Eureka	Research Institute of Metals, Ltd. Panenské Břežany	Development of technology of thin aluminium sheets production for the application in air conditioning and refrigerating technology.	Resulted in the recommendation to change the technology of production of bands for finstocks and methodology of ductility examination. Method was applied at industrial partners (Hutní závody Břidličná) and yielded a substantial improvement of quality of finstocks, triple increase of production volume and decrease of energy consumption.
Ministry of Health	Faculty Hospital Motol	Re-synchronisation during operations of in-born defects of children.	Positive relation of the temporary heart re-synchronisation and negative relation of di-synchronic activation of left and right heart chamber during corrective operations of in-born heart defects of children have been proven.
Ministry of Health	Institute of Clinical and Experimental Medicine, Prague	Genetic determination of early arteriosclerosis.	Candidate gene for this burden was discovered. Gene for CD 14 receptor on lular membrane of monocyte is a receptor of lipopolysacharides, molecules related to infection.
Ministry of Agriculture	Research Food-processing Institute, Prague	Functional model of laboratory sectional apparatus for the research of influence of high pressure upon the food-processing technologies.	Prototype of apparatus for the treatment by high pressure with a volume of chamber of 1.2 l is used for non-heat treatment of food.
Ministry of Agriculture	Research Institute of Plant Production, Prague-Ruzyně	Finding of appropriate agro-technical measures with a view to the restriction of risks of contamination of hydro-sphere by nitrates.	It was found that while farming on soils in areas of protection of water sources it is recommendable while sowing winter wheat following the clover plants to use plough-less systems or to plough late in autumn or at the end of winter and to use as the subsequent plants e.g. corn, potatoes, oats, barley etc. The results are used in implementing the Nitrate directive in the CR.

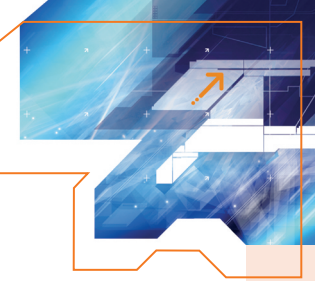


Provider	Organisation	Output	Description of output, benefits
Ministry of Agriculture	Research Institute of Veterinary Medicine, Brno	Protection of the territory of the Czech Republic against paratuberculosis of ruminants, programme for its reduction.	The results shall enable to improve the system of control of foodstuffs with a view to the protection of consumers, domestic producers and financial interests of the republic. Methods have already been implemented in controls of the Czech Agriculture and Food Inspection.
Ministry of Environment	Czech Geological Survey, Prague	Set of geological and thematic maps 1:50 000. Completed geological, hydrogeological, mineral resources, engineering-geological, soil maps and maps of the geochemistry of surface water, of conflict of interests etc.	Czech Republic is the first country in the world the territory of which is mapped in this manner. Maps are used by the state administration for political, economic and ecological decisions, for the elaboration of land-use plans. It is used also by exploration, mining and industrial enterprises as well as for pedagogical and educational purposes. Irreplaceable source of information on geological structure of the territory of the republic.
Ministry of Environment	Institute of Experimental Medicine of the Academy of Sciences of the CR	Teplice II – stipulation of risks of air pollution for health.	Resulted into the conception of long-term monitoring of inhabitants, changes of health condition of the population. Also the control of decrease of pollutants content in the atmosphere. Extraordinarily important aspect of the European standpoint.
Ministry of Environment	Water Economy Research Institute of T.G.M	Project Labe II – complex synthesis of factors influencing the pollution of Labe River waters and recommendations of sanative and protection methods.	Results used by the state administration bodies in the fulfilling of State Environment Policy. Important also for the instruction of the public and non-governmental organisations. Successful co-operation with German organisations.
Non-state sources	ATEKO, joint stock company Hradec Králové	High-evolution turbo-chargers	In 1998 low-temperature turbo-compressor was supplied to CERN (Switzerland), in 2001 turbo-circulator of super-pure mixture Ar + CO <sub>2</sub> . In 2001 this machine was awarded the golden medal at the International Mechanical Engineering Fair.



Provider	Organisation	Output	Description of output, benefits
Non-state sources	Institute of Nuclear Research, joint stock company, Řež	Construction and operation of Positron Emission Tomography in the Homolka Hospital.	Positron Emission Tomography Centre is a joint workplace of the Institute of Nuclear Research in Řež and Homolka Hospital. The utilisation of cyclotron facilitates the advanced non-invasive examination, particularly oncological and cardiological.
Non-state sources	Research Institute of Energy Machines, joint stock company, Brno	High dynamics and efficiency drives with synchronic motors excited by precious earths magnets.	Assigned for demanding markets of Germany and USA. Volumes of motors are app. 2.5times smaller than that of classical motors. Envisaged volume of realisation in 2002 is CZK 25 mil.
Non-state sources	Research Institute of Energy Machines, joint stock company, Brno	Systems of waste heat and gas energy implementation for energy production.	In Český Brod a co-generation aggregate was built. The project results facilitate to economy the material, implementation of the built-up area and represent smaller environmental hazard. The project was awarded the price "Innovation of the year 2000".

## G. Economic performance and research and development



### G 1. Gross domestic product per head between 1996 and 2000

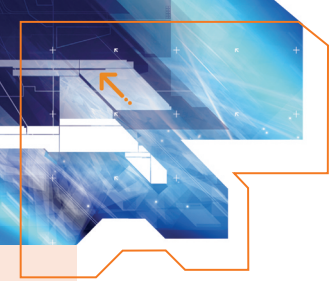
(GDP per head expressed in USD at purchasing power parity)

Country	1996	1997	1998	1999	2000
Czech Republic	12 995	13 135	13 081	13 591	14 250
Denmark	24 340	24 743	25 721	27 564	28 366
Finland	19 422	20 464	21 780	22 568	24 418
France	20 324	20 438	21 333	22 225	23 269
Japan	24 505	25 060	25 234	25 589	26 396
Hungary	9 322	9 826	10 445	11 232	12 013
Germany	21 600	22 221	22 859	23 743	24 942
the Netherlands	21 875	23 158	24 700	25 947	27 502
Poland	7 359	7 310	8 190	8 651	9 183
Austria	22 388	22 900	23 605	24 669	25 770
Greece	13 359	13 568	14 340	15 154	16 063
United Kingdom	19 965	20 977	22 070	22 882	23 993
USA	29 194	30 798	32 262	33 836	35 090
EU	19 162	20 058	21 286	22 000	23 500

Source: OECD – Main Science and Technology Indicators, 2001/2 Annex 3

#### Commentary

1. Economic performance of a country as measured by gross domestic product per head (GDP/head) is undoubtedly affected by R&D. However, research and development influence these indicators only indirectly. Interposed between R&D results and GDP/head are processes involved in transfer of R&D results, mostly demanding on time, funds and organisation, and accompanied with construction, marketing, trade, and services provided to distributors, customers etc. Persons and organisations involved in R&D usually no longer participate in these processes. The relationship between R&D and economic level is complex. Nevertheless, based on long-term experience with practical policies investments in R&D are considered in standard economies to be pro-growth expenditures and rank among factors promoting productivity of both labour and capital. A similar situation prevails in pro-growth investments in education.
2. In fact the only OECD member state having large level of GDP/head (393 000 USD/head) and low expenditures in R&D is Luxembourg. Economic prosperity of Luxembourg is based on financial services.
3. Economic performance of the Czech Republic measured by GDP/head is considerably smaller than that existing in the EU. In 2000 the Czech Republic attained 61 % of the EU mean value, but exceeded that of other candidate countries.
4. The indicator of average annual GDP increments for a certain period reveals the relationship with R&D performance. The following table has been taken from the material of the German Federal Ministry for Education and Research (BMBF) Zur technologischen Leistungsfähigkeit Deutschlands 2001.



#### **Average GDP increments (%) in the economically developed countries, 1994–2001**

Ireland	Luxembourg	Finland	Spain	USA	Portugal	the Netherlands	Greece
9.3	8.5	4.2	3.7	3.4	3.3	3.2	3.2

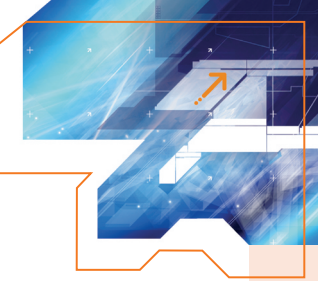
Sweden	G. Britain	Belgium	Denmark	France	Austria	Italy	Germany
2.8	2.7	2.5	2.4	2.3	2.2	2.1	1.7

#### **Annual GDP increments in the Czech Republic**

1996	1997	1998	1999	2000
4.8	-1.0	-1.2	-0.4	2.9

*Source:* Czech Republic 2001 – Mixed Blessing, CERGE-EI, December 2001

4. Countries having the highest annual GDP increments – Ireland, Finland and Spain – in the same period dynamically increased R&D expenditures. However, the increase of R&D expenditures was accompanied by equally dynamic restructuring of industry. High increments of Luxembourg are explained by further increasing and improvement of financial services. Low annual increments in Germany are caused by solving the problems related to the unification of Germany. Japan whose average annual increments in the period were only 1 % is not included into the table.
5. GDP development in the Czech Republic is related to considerable problems of the privatisation which is being completed and the necessary restructuring of economy. In 2000 more substantial growth was evidenced. Preliminary results show that the GDP increment in 2001 might be higher than 3.5 %. Such a favourable prediction applies also for 2002.



## G 2. Competitiveness

Since 1996, numerous expert teams have been engaged in a detailed assessment of competitiveness. The results are presented to the annual World Economic Forum. Competitiveness is assessed pursuant to several hundreds of criteria divided into several groups. One of those is R&D assessed by means of 26 criteria. The assessment is in banking and financial world considered to be objective and expected every year with great expectations. Details, particularly on the assessment in 2001, are presented in the separate part of the analysis "Assessment of R&D of the CR in foreign documents" (Part J).

The development of the placing of the Czech Republic in the overall assessment of competitiveness and assessment of R&D is demonstrated in the following Table.

### Placing of the Czech Republic in the competitiveness according to the evaluation for the World Economic Forum

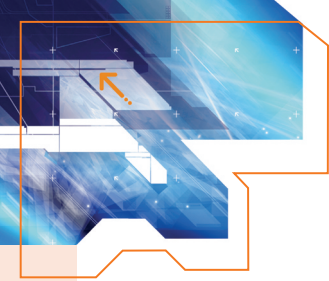
	1996	1997	1998	1999	2000	2001
overall competitiveness	34	35	38	41	34	35
R&D	43	44	37	41	38	30

### Commentary

1. The placing of the Czech Republic following the temporary decrease in 1999 has been increasing in the overall competitiveness since 1998. In 1996 and 1997 the placing in the overall competitiveness was substantially better than the placing in R&D. However, in 2001 R&D was assessed distinctly better than the overall competitiveness.
2. Statement on the substantial influence of R&D and the introduction of its outputs into practice on the economic level unanimously confirms the placing of Finland in the assessment of competitiveness in between 2000 and 2001 and competitiveness growth in comparison with the preceding year. For details see a separate part of the Analysis.

### Placing of Finland in the assessment of the overall competitiveness and competitiveness growth produced for the World Economic Forum

	2000	2001
competitiveness	1	1
competitiveness growth	5	1



## G 3. Foreign trade

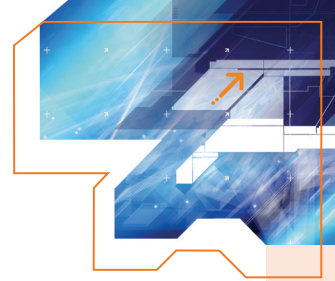
### G 3. 1 Percentage of export of industrial sectors that impose high demand on R&D of the total export (in % of the total export)

Country	Electronic industry		Office machines, computers		Pharmaceutical industry		Instruments	
	1996	1999	1996	1999	1996	1999	1996	1999
Czech Republic	0.21	0.25	0.13	0.14	0.3	0.21	0.22	0.24
Denmark	0.7	0.7	0.6	0.5	2.9	2.6	1.4	1.3
Finland	1.7	2.2	0.6	0.4	0.3	0.3	0.6	0.7
France	5.2	5.4	5.7	4.9	9.9	10.6	5.6	5.2
Japan	25.3	18.8	20.3	15.7	3.5	3.0	16.7	14.9
Hungary	0.2	0.7	0.03	1.6	0.43	0.33	0.15	0.16
Germany	7.8	7.3	7.0	6.8	14.8	15.1	15.1	14.1
the Netherlands	3.3	3.3	9.6	10.6	5.7	4.0	4.4	5.0
Poland	0.2	0.3	0.04	0.04	0.36	0.16	0.11	0.12
Austria	0.7	0.8	0.35	0.42	1.7	1.7	1.0	1.0
Greece	0.03	0.04	0.01	0.03	0.1	0.15	0.06	0.04
United Kingdom	7.7	6.7	10.8	10.3	11.4	10.0	7.4	6.9
USA	19.2	23.7	23.0	23.1	10.6	12.0	22.9	25.9
EU	17.6	16.2	12.1	12.3	33.9	33.1	23.1	21.6

Source: OECD, International Trade Statistics database, November 2001

### Commentary

1. It is remarkable that except USA the shares on export of products that impose high demand on R&D of other countries of G 7 group decrease. In other groups except the group of office machines and computers the share of EU as a whole decreases. Technological advancement of economically developed countries ahead of other countries is not ensured forever. On international markets with advanced products and technologies, the competitors from rapidly developing countries have been asserted for several years already.
2. Rapidly developing countries which have an opportunity to assert on demanding markets may be divided into three groups:
  - "Asian tigers" – Korea, Taiwan and Singapore,
  - Middle- and East European countries – Czech Republic, Slovakia, Poland, Hungary, Slovenia and Estonia which follow the industrial traditions and have a good standard of education,
  - other Asian countries as Malaysia and Philippines which already play important role on micro-electronics markets.
3. Middle- and East European reformatory countries and rapidly developing countries of Southern Asia show completely different tendencies in the development and dynamics of R&D. In the mentioned countries following the political and social changes at the beginning of the 1990s the expenditures on R&D substantially decreased from the values relatively high to the value which is



markedly under-average of expenditures of OECD member states. Since the middle of the 1990s the expenditures have been slightly increasing. On the other hand, Korea, Taiwan and Singapore started with R&D expenditures which were substantially lower. However, the expenditures have been dramatically increasing. Despite considerable economic problems, in 1999 Korea reached the total expenditures on R&D in the amount of nearly 2.5 % of GDP, Taiwan and Singapore on the level slightly above and below 2 %.

4. Czech Republic data mentioned in the previous Table confirm that even at the absolutely low share on the overall export it is greatly increasing. More detailed data are demonstrated in the following Table:

### G 3. 2 Import and export of hi-tech products in the Czech Republic (data in per cent of overall import/export volume, CZK billion, current prices)

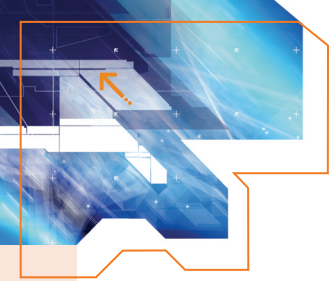
	1996	1997	1998	1999	2000	2001
<b>Import</b>						
■ in % of overall volume of import	11.4	11.1	12.0	12.7	14.1	15.0
■ in CZK billion	85.78	95.88	111.96	123.14	174.9	207.9
<b>Export</b>						
■ in % of overall volume of export	6.66	7.2	7.4	6.6	7.8	9.1
■ in CZK billion	39.6	51.8	63.2	59.8	87.7	115.3
Export/Import	0.46	0.54	0.56	0.49	0.50	0.55

Source: Ministry of Industry and Trade – analytical department

### Commentary

1. The development of hi-tech products share in foreign trade has been increasing both in export and import over long run. This group includes aviation technology, electrical engineering, electronics, telecommunication, computer products, scientific appliances, pharmacy, chemistry (synthetic dyes, insecticides, herbicides, fungicides, radioactive materials), non-electric machines.
2. Share of hi-tech products in 2001 on the overall export amounted to 9.1 % (CZK 115.3 billion) and has increased on the year earlier by 1.3 points. The largest export item was computer technology having the volume of CZK 36.3 billion with the one the year earlier growth of nearly 115 %, electronic and telecommunications with the amount of CZK 33.8 billion with the growth of 64 %. These two items made up more than 60 % of hi-tech export.
3. In 2001, import of hi-tech products in the amount of CZK 207.9 billion represented 15 % of the overall import which is 0.9 points more than that in 2000. Electronics and telecommunications had a volume of CZK 79.7 billion an increase of 15.1 % on the previous year which placed in on the first position, followed by computer technology having the amount of CZK 58.4 billion (growth almost by 50 %) and scientific appliances with CZK 18.4 billion (growth by 17.2 %).





## G 4. R&D expenditures of industrial sectors

### G 4. 1 Expenditures of industrial sectors in the USA (in per cent of turnover)

Sector	1996	1997
Basic and processing industry	1.1	1.0
Information technology and electronics	6.4	7.0
■ computer networks equipment	11.9	12.6
■ software	15.3	15.0
Mechanical engineering and electrical engineering	2.8	2.8
Pharmaceuticals and medical care apparatus	11.5	11.8
Motor vehicles	4.4	3.6
Aircraft and aerospace industry	3.6	3.6

Source: Science & Engineering Indicators – 2000, NSF, USA

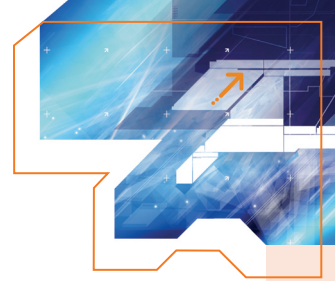
### G 4. 2 Expenditures of industrial sectors in the UK (in per cent of turnover)

Sector	1993	1994	1995	1996	1997	1998
Chemical industry	3.1	2.6	2.5	2.4	2.7	2.8
Pharmaceutical industry	25.7	27.4	28.0	31.4	32.6	34.2
Mechanical engineering	1.9	2.0	1.6	1.5	1.5	1.6
Electronics	6.5	5.7	3.6	3.2	3.2	4.0
Other electrical engineering industry	5.6	3.6	3.6	4.2	3.8	4.0
Motor vehicles	2.8	2.5	2.5	3.0	3.0	2.9
Aircraft and aerospace industry	10.9	10.0	11.3	8.6	7.6	8.0
Other processing industry	0.5	0.5	0.5	0.5	0.5	0.6

Source: SET Statistics 2001, Department of Trade and Industry, UK

## Commentary

1. The amount of expenditures on R&D, both overall and from business sources, depends on the structure of economy, particularly on the structure of industry. The increase of expenditures on R&D in the countries in which industrial sectors that impose high demand on R&D prevail shall not bring about more substantial growth of economic performance, unless accompanied by a substantial restructuring of research and development. Private business sector usually correctly decides on the most appropriate instruments for the maintenance and development of competitiveness. Data presented in the previous Tables certify this fact.



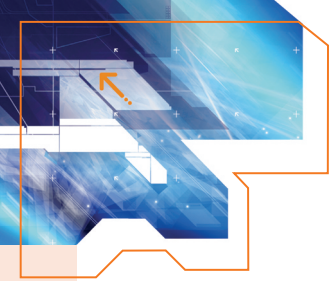
2. In most countries, non-specific mechanical engineering and electrical engineering are considered to be the sectors not imposing high demand on R&D. In the USA the average expenditures on R&D are almost 3 % of the turnover, in Great Britain are higher – recently amounting to 1.5 % of the turnover. These are average values, individual enterprises devote on R&D substantially more, but also less.
3. Pharmaceutical industry shows high expenditures on R&D. In Great Britain these expenditures on R&D exceed 30 % of turnover and are still growing. In the USA the production of pharmaceuticals is assessed together with the production of medical apparatus and the expenditures exceed 11.5 % of turnover. Also the pharmaceutical companies in Switzerland, France, Germany and Canada show high expenditures on R&D.
4. Expenditures on information technologies and electrical engineering industry in the USA in the given years range between 6.4 and 7 % of turnover. In Great Britain the value dropped from 6.5 % in 1993 to 4.0 % in 1998. However, there are considerable differences among individual sectors. In the Table G 4. 1 for the USA there are two sectors of the electrical engineering industry having substantially higher expenditures on R&D: computer network equipment and software. Expenditures in both sectors range between 12 and 15 % of turnover.
5. In the sphere of motor vehicles production the expenditures on R&D in both assessed countries range around 3 % of turnover and are almost double as in other segments of mechanical engineering.
6. The drop of expenditures in aircraft and aerospace industry of Great Britain from 10.9 % in 1993 to 8.0 % in 1998 is rather surprising. The subsidies to R&D and state contracts in R&D are not included in the expenditures on R&D in the USA (3.6 % of turnover).
7. Expenditures in the processing industry in both the USA and Great Britain range around 1 % of turnover.

## G 5. "Hi-tech" – methodological supplement

### Products imposing high demand on R&D

Industrial sectors imposing high demand on R&D are the most important suppliers of advanced products and technologies. These sectors include the branches with over-average demand on R&D. The sphere of hi-tech technologies include the groups of products with a share of expenditures on R&D higher than 8.5 % (e.g. pharmacy, computer technology, aeroplanes, weapons). The sphere of medium hi-tech technologies include products having the share of expenditures on R&D on turnover in the range of 3.5 up to 8.5 % (e.g. automobiles, mechanical engineering, electronics, chemistry). Both spheres together form a sphere imposing high demand on R&D. Products imposing high demand on R&D (sum of hi-tech and medium hi-tech technologies) are the synonyms for the industrial sector imposing high demand on R&D (identical concepts to those of "hi-tech" and "Schumpeter's products").

The difference between hi-tech and medium hi-tech technologies cannot be understood in the manner that the sphere of medium hi-tech technologies is "older" or "less valuable" and the sphere of top technologies is "newer" and "more modern" or "more valuable". The spheres differ in the level of intensity of R&D (demand on R&D) and degree (level) of protectionism. Hi-tech technologies products show the highest intensity of R&D, they often have a "profile function" (e.g. information technologies, bio-technologies) and the State often influences them through subsidies, government contracts (e.g. aircraft and aerospace industry). State institutions of all industrial countries pay increased attention to the sphere of hi-tech technologies. Through the support of this sphere, state institutions pursue not only technological aims, but also specific aims of the state (e.g. external safety, health etc.). Certain exceptions must be respected in the aggregate assessment of individual branches of economy.



## Services imposing high demand on knowledge

The meaning of services as a sector with a substantial share of employment and high share of excess value increases. Many spheres of services are becoming technologically intensive (imposing demand on technologies) through the volume of own R&D activities and applications of technologies from the industrial sectors. Therefore even the services imposing high demand on knowledge are included into the analyses of economic structures.

The basis of the specification of economic activities which are imposing over-average demand on knowledge is a knowledge of personnel, i.e. qualification requirements on employees (particularly the share of university education graduates, mostly naturalists and engineers) and functional specifics (e.g. engagement in research, development, planning, design etc.). Not only economic sectors imposing high demand on technical and technological equipment are characterised by a large share of basic capital, but all sectors of economy, which impose high requirements on the qualification of employees (medical care, media and financial services etc.).

There are very detailed lists of production sectors and services, which divide the sector into individual categories pursuant to the demand imposing on research and development.

Foreign materials classify – with an acceptable simplification – eight production sectors (branches) as hi-tech branches. These are:

- Production and repair of aeroplanes and artificial cosmic bodies
- Computers and office technology
- Electronics except computers and office technology
- Pharmaceutical industry
- Scientific apparatus
- Chemical products
- Motor vehicles
- Electrical engineering

First four branches are hi-tech industries, the remaining four are medium-hi-tech industries.

The Ministry of Industry and Trade in co-operation with the Czech Bureau of Statistics applies the concept hi-tech in their analyses of foreign trade. Hi-tech concept includes both the hi-tech and medium hi-tech technologies.

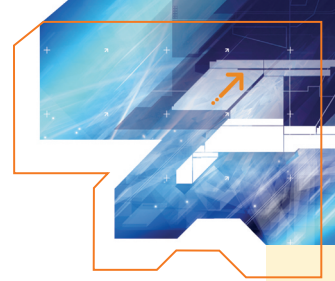
## Vocabulary of concepts used in analytical materials on R&D

Czech	English	German
špičkové technologie <sup>1</sup>	hi-tech	Spitzentechnologie
pokročilé technologie <sup>2</sup>	medium hi-tech	Hochwertige Technologie
špičkové+pokročilé technologie, technologie náročné na VaV někdy i high-tech	sometimes hi-tech	FuE-intenzive Güter

<sup>1)</sup> Aircraft and aerospace industry products, office technology and computers, pharmaceuticals and health care apparatus, telecommunication and information equipment.

<sup>2)</sup> Motor vehicles, chemical industry products, mechanical and electrical engineering products, other transport equipment.

## H. Assessment of the fulfilment of the National Research and Development Policy of the Czech Republic of 2000



*In this chapter the fulfilment of the Resolution of the Government of January 5, 2000 No. 16 by which the National Research and Development Policy of the Czech Republic (hereinafter "NR&DP") was approved and the fulfilment of individual chapters are assessed. The assessment is structured as follows: the characteristics of the chapter (part) content; description of main activities in the corresponding sphere; quantitative assessment of activities; recommendations for the preparation of a new NR&DP. The assessment takes into account the importance of individual parts of NR&DP.*

The Government, through its Resolution No. 16 of January 5, 2000 on the National Research and Development Policy of the Czech Republic in point II approved this Policy and in point III imposed four assignments. The approved policy has the form of 250 articles arranged into 5 chapters.<sup>1</sup>

### A. The fulfilment of tasks following from the resolution of the Government

#### III. 1 – to compile and submit to the Government a material intention until June 30, 2000 and the bill on research and development until October 31, 2000

This assignment was imposed upon the President of the Research and Development Council in co-operation with the Minister of Education, Youth and Sport, other members of the Government, heads of central authorities and the Presidents of the Academy of Sciences of the Czech Republic and the Grant Agency of the Czech Republic.

The Policy anticipated that only a single act would be drawn up solving the whole issue of R&D including the matters of transformation of state budget and contributory organizations engaged in R&D. However, in the course of the preparatory work it appeared that it would be reasonable to divide the problem into two separate acts.

Therefore the Government by its Resolution No. 460 of May 10, 2000 on the organizational assurance of state administration execution in R&D imposed to prepare two acts – bill on R&D and bill on Public Research Institutions (hereinafter "act on PRI").

Due to the gradually approved schedule of the Government, the terms were shifted for objective reasons. The Resolution of the Government of February 14, 2001 approved the material intention of the act on R&D and on the amendments of some related acts. The same resolution imposed to draw up and submit to the Government the bill on R&D on May 31, 2001.

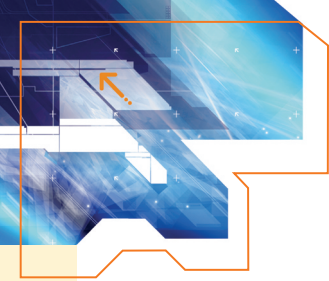
The bill on R&D was submitted to the Government in the fixed term and the Government approved it by its Resolution No. 572 of June 13, 2001.

The Chamber of Deputies of the Parliament of the Czech Republic approved the bill on R&D support on February 6, 2002. The proposal was approved by the Senate of the Parliament of the Czech Republic, signed by the President and published in chapter 56 of the Collection of Laws under No. 130/2002 Coll.

During the discussion on the continuation of the interrupted first reading of the act on R&D support (it was interrupted due to the related act on PRI) the major parts of the act on PRI were incorporated into the act on R&D support in the form of amendments. Related to it, the Government by its Resolution No. 900 of September 12, 2001 on the modification of the procedure of the preparation of a bill dealing with public research institutions cancelled the above-mentioned Resolution No. 460 of May 10, 2000. At the same time the Government imposed by March 31, 2002:

1. to produce a legal analysis of possible variants of the solution of public research institutions issue,
2. to produce and submit to the Government a proposal of the procedure of preparation of a new legislation concerning institutionally supported state contributory organizations engaged in R&D.

<sup>1</sup> Resolution of the Government No. 16/2000 as well as the NR&DP are available at addresses: [www.msmt.cz](http://www.msmt.cz); [www.vyzkum.cz](http://www.vyzkum.cz).



The analysis pursuant to point 1 was drawn up, the proposal of the procedure was submitted to the Government in the fixed term. The Government by its Resolution No. 400/2002 imposed upon the Research and Development Council of the Czech Republic, in co-operation with the Ministry of Education, Youth and Sport and the Academy of Sciences of the Czech Republic to submit the proposal of a material intention of act on public research institutions by November 30, 2002.

**III. 2 – to announce public tender for the preparation of sub-programmes of the National Programme of Oriented Research and Development no later than April 30, 2000 and to submit the Government the proposal of the National Programme of Oriented Research and Development no later than April 30, 2001**

This assignment was imposed upon the Minister of Education, Youth and Sport in cooperation with the President of the Research and Development Council, other members of the Government and heads of central authorities.

Public tender was announced in the stipulated term. However, due to the shortcomings of a single bid and its removal from the tender it was cancelled. In accordance with Article 49 (2) c) and Article 49 (3) a) of Act No. 199/1994 Coll. on the assignment of public procurements as amended, after that the public tender was assigned on the basis of a bid of several prospects on the public bid – the invitation to tender was sent to four subjects which were interested in the procurement already during the public tender (i.e. the tenderer and also to three other subjects which claimed during the public tender the commissioner documents, but for the reason of lack of time did not submit the offer). Therefore in April 2001 the sponsors asked for the shift of the term, which was newly stipulated by the Resolution of the Government No. 467 of May 9, 2001 to April 30, 2002. The public tender was in accordance with the concluded contract delivered to the Ministry of Education, Youth and Sport as a contracting authority in December 2001. The proposal of the National Programme of Oriented Research and Development is being presented to the Government together with this documents.

**III. 3 – to produce the R&D conceptions of individual resorts and to submit it to the President of the Research and Development Council**

This assignment was imposed upon the members of the Government, heads of the other central authorities and the presidents of the Academy of Sciences of the Czech Republic and the Grant Agency of the Czech Republic.

The assignment was fulfilled. An independent part of R&D analysis deals with the assessment of the fulfillment of conceptions of individual resorts.

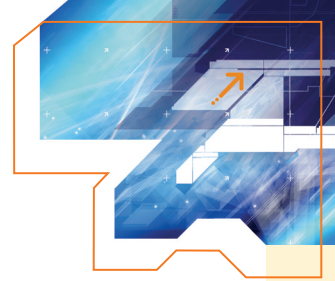
**III. 4 – to produce the proposal of the organizational assurance of the state administration execution in the sphere of R&D in a new act on R&D in accordance with the Policy and the proposal of the procedure of this new act preparation and to submit it to the Government no later than February 29, 2000**

The proposal was submitted. On the basis of it the Government adopted the above-mentioned resolution No. 460 on May 10, 2000 and the solution of this problem was divided into the preparation of two acts.

The assignment was fulfilled.

In point IV. of the Resolution the Government recommended the scientific and academic community, organizations engaged in R&D, users of R&D outputs and other subjects to implement the Policy in their activities, particularly in the spheres dealing with morale and ethics, public relations and R&D management.

Short information on how this recommendation of the Government was put into life is given in the assessment of the individual parts of NR&DP.



## B. Fulfilling the NR&DP

### Part I. PREAMBLE and part II. BASIS

In these two parts, the meaning of R&D is characterised, main aims of the policy are stipulated and the reasons why the Czech Republic needs the R&D policy are explained. In the following parts of the policy, the principles, aims and measures for their attainment are specified in detail. Assessment of their fulfilment is made in the corresponding parts of the text.

It follows from the comparison with similar foreign documents, including the EU documents on the European Research Area, that this part of the policy is formulated in a modern and correct way, that it is the question of aims and principles of their fulfilment with a longer-term validity.

The dynamics of internal and external (foreign) conditions for the development of R&D affirmed the correctness of the decision that the policy will have to be updated in two years.

### Part III. – PRINCIPLES AND VISIONS

In this part, the main principles of the policy are formulated in several sub-chapters: openness and flexibility; transparency during preparation and implementation; necessity of relation with other spheres, namely with the sphere of education; respecting the conditions of world globalising economy and policy in the broader sense; the requirement of increased emphasis on the results of research and their quality.

#### III. 1 Openness, flexibility and transparency

This principle was respected during the preparation of legal provisions and proposal of the expenditures of the state budget on R&D. Public discussions were opened with regard to many documents, with information provided regularly to the mass media. Despite certain difficulties, particularly in the first period, it is possible to state that the principle proved to be correct and it will be necessary to adhere to it in the future. The above-mentioned difficulties included first of all the fact that the openness and transparency was diminishing from the managing bodies of state administration down to the institution of individual sectors of R&D to individual R&D organisations. State administration bodies called upon the representatives of all R&D sectors to prepare important documents, in lower levels such an approach was rather an exception. It seems that the full implementation of this principle requires a certain time of mutual learning. The discussions lacking any clearly defined themes and regulations, were often futile and did not reach particular consensual recommendations. Time, financial and personnel requirements for the assurance of required openness and flexibility were underestimated to a certain extent.

It is recommended for the future policy to adhere to this principle, paying more attention to the methodological and capacity assurance.

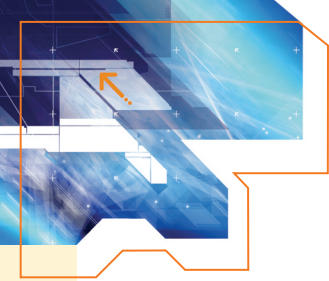
#### To III. 2 Interconnection with other spheres

This chapter deals with the need to tie the R&D policy with other national policies and with the tie of R&D infrastructure with other sectors of national economy as the R&D infrastructure fulfils also other functions (not only for R&D).

During the period of validity of NR&DP, it was not succeeded to line-in sufficiently the NR&DP with major policies (e.g. industrial, energy, agricultural). One of the exceptions is the Middle-Term Conception of Social and Economic Development of the Czech Republic produced by the Social and Economic Strategy Council of the Government. It summarises the conception of national economy sections and on the basis of it envisages weak and strong sides of the state development.

This task remains to be solved in by the future policy.





### **To III. 3 Education and R&D**

This chapter deals with the relation of education and R&D. It particularly stresses the interconnection of university education with research and development at the universities.

In the course of the validity of NR&DP, the financing of a specific research at the universities as a special kind of research designated for the support of master's degree, doctoral and post-doctoral study and for the strengthening of ties between the education process and research and development. Rules for the support of specific research at the universities, including the criteria for the division of financial means, were incorporated into the Act on research and development support and into the implementing provisions to this Act. The criterion of a substantial representation of young research workers was applied in certain major programmes, e.g. the Program of Research Centres. The Grant Agency of the Czech Republic and the Grant Agency of the Academy of Sciences of the Czech Republic introduced special programmes for the support of young research workers up to 35 years.

Recommendation for the future policy: to continue supporting specific research.

### **To III. 4 External openness, opportunities and risks of co-operation**

Presumptions on opportunities and risks of ongoing globalisation were fully affirmed. A substantial part of the proposed measures for the implementation of policy in the legal, financial and organisational spheres fully respected that R&D in the Czech Republic should be exposed to more challenging competition, that R&D would have to be included into the globalising processes accompanying particularly the creation of the European Research Area while at the same time preserving its peculiarity. However, these measures were not implemented, as seen below.

The future policy will have to pay considerable attention to the aspects of globalisation, to the expansion of competition in R&D, increasing speed of creation of new knowledge in R&D, their transfer to the users and increased mobility of R&D workers.

### **To III. 5 Orientation at the results and their quality**

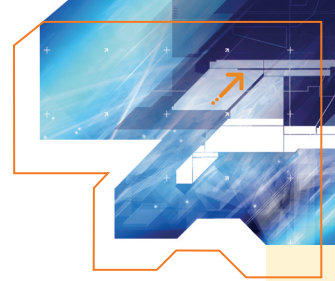
The chapter dealing with the assessment of R&D not according to the activities and invested financial means, but primarily according to the accomplished results and with the manner of their assessment by means of methods usual abroad. The results of assessment should have been one of the criteria for the distribution of available financial means including the application of a "better ones get more" principle.

During the validity of NR&DP, it succeeded in incorporating principles to assess research not only according to the activities and inputs but according to the results into the Act on R&D support. The effects have not displayed yet as R&D is a long-term activity and during the validity of the policy the projects commenced pursuant to old rules are gradually completed. The principle that they must be assessed according to the same rules at their termination applies. This inertia is three to five years.

It was not succeeded to establish university institutes aimed only or mostly at R&D. The reasons lie in legislative restrictions.

The principle "better one gets more" was applied provided the volume of financial means of the state budget on R&D allowed it. This principle was applied not only in the elaboration of proposals of expenditures of the state budget for R&D but also in assessing research plans of research organisations at the level of the Research and Development Council of the Government of the Czech Republic or at the level of the Ministry of Education, Youth and Sport.

Recommendations for the future policy: to strengthen the stress upon the assessment pursuant to the envisaged results while considering the project proposals and upon the assessment pursuant to the attained results after the completion of the project.



## IV. AIMS AND PRIORITIES

This part is divided into two sub-chapters, a sub-chapter on the system priorities and a sub-chapter on material, thematic priorities. Each of the sub-chapters is divided into independent parts. The sub-chapter on system priorities deals with individual sectors of R&D (basic research, applied research, development and transfer), inter-sector co-operation, human resources, regional aspects and international co-operation. The sub-chapter on material, thematic priorities has two parts: specialisation of a non-oriented research and priorities of an oriented research.

The development in recent years shows that the developed countries have made an effort to eliminate the barriers of the co-operation between individual sectors, to shorten the process of transfer of knowledge from the basic research through the applied research and development to the user. However, differences in conditions, manners and scope of support of individual sections of R&D, differences in organisational structure etc. still remain. The structure of the sub-chapter on system and thematic, material priorities is basically correct and should be implemented with minor changes also in the future policy.

### To IV. 1. 1 Basic research

In this part, the need and necessity to reach the superior results, to strengthen the dependence of the amount of support on the attained results is stressed. The policy undertakes to support the participation of basic research workplaces in domestic and international programmes of oriented research.

It is necessary to mention that the stipulated aims were attained only partially. The system of provision of financial means still does not sufficiently differentiate the level of achieved results. The increased support devoted to basic research was not accompanied by corresponding increase of basic research performance. This statement applies not only in the sphere of basic research but also in the sphere of R&D in the Czech Republic as a whole. The increase of performance, differentiation of quality of achieved results are apparently longer-term processes. Administrative barriers of the participation of basic research workplaces in the oriented research programmes were substantially eliminated.

Future policy should increase the stress upon the increase of basic research performance while preserving free and creative environment in basic research workplaces.

### To IV. 1. 2 Applied research

The main aim in this sphere was to eliminate the shortcomings of the existing R&D programmes, absence of co-ordination, shortcomings in management etc. However, only a slight improvement was reached, particularly thanks to the new legal provision on the targeted support of R&D.<sup>2</sup> Substantial improvement is expected to be attained through the National Oriented Research and Development Programme (hereinafter "NOR&DP").<sup>3</sup>

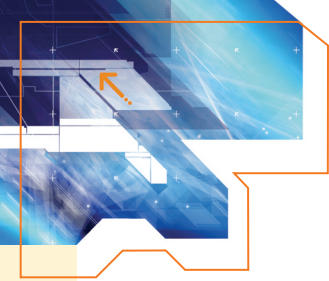
The development of R&D infrastructure was promoted by several programmes co-ordinated by the Ministry of Education, Youth and Sport. The attainment of more pronounced progress was hindered by the limited amount of financial means in this sphere and the absence of conception of the infrastructure development with clearly stipulated priorities. New act on R&D support creates substantially better conditions for the R&D infrastructure development.

The future policy should also in this section continue to strive to increase the performance and effectiveness, not only by eliminating the shortcomings of legal and organisational framework. The demandingness and objectivity of assessment of attained results must increase and the dependency of the amount of support should be related with the achieved results.

<sup>2</sup>) Government Regulation No. 88/2001 Coll. on the conditions of targeted financing of research and development and the transfer of data into the central evidence of state-supported research and development projects as amended by the Regulation of the Government No. 378/2001 Coll.

<sup>3</sup>) Act on research and development support introduces the term "National Research Programme".





#### To IV. 1. 3 Development and transfer

In this sub-section, the principles currently used abroad to shorten the process of transfer of knowledge from the basic research through other links to the implementation in new products, technologies and services were applied. In this sub-section, the principles currently used abroad to shorten the process of transfer of knowledge from the basic research through other links to the implementation in new products, technologies and services were applied.

In this sphere very small progress was achieved. The main reasons include already mentioned insufficient interconnectedness of R&D policy with the policies in other important economic and social spheres, still insufficient interest of private companies in R&D results – the restructuralsing of economy proceeds more slowly than it was expected. One of the barriers was the so far unresolved adjustment of rights to the R&D results. These rights are covered by a new act on R&D support.

It did not succeed to convincingly reason and implement indirect instruments of R&D support, which has been already applied abroad for many years (see V. 1. 6).

Future policy must continue to strive for a substantial speedup of transfer of R&D knowledge to the users. The introduction of indirect instruments of R&D support, including the transfer, should be the priority of the future policy.

#### To IV. 1. 4. Human resources

The sphere of human resources includes the set of all necessary measures which shall lead to the improvement of personnel basis of R&D in the Czech Republic. First of all, it is a question of age structure, migration and the improvement of working motivation, including career opportunities.

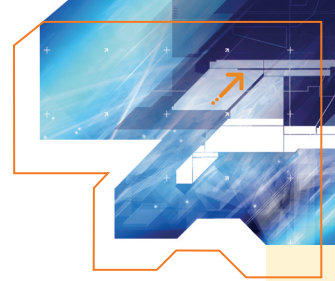
Complex solution of the problem of ever-increasing age average of R&D workers of the state sector is a long-term issue and its solution exceeds the term of validity of this NR&DP. So far, the age average has been decreasing only in the sphere of molecular biology, biochemistry, information technologies, programming and mathematics.

It is possible to positively evaluate the legal stipulation of conditions for specific research at the universities. Arousal and cultivation of interest in research and development activities in students of university programmes contributes to the recruitment of graduates into the sphere of R&D.

It is possible to observe the facilitation of international mobility with regard to the fellowships for a limited period of time granted on the basis of international co-operation (UNESCO, Marie Curie Fellowship etc.). However, substantial shortcomings still persist in engaging other foreigners into R&D as the legal and administrative barriers preventing the migration of scientists and researchers into CR has not been abolished yet.

While the workers of state research sphere relatively often transfer into industry, the reverse process in the Czech Republic, unlike developed countries, is quite seldom. In this sphere it is possible to expect a certain improvement particularly in connection with the establishment of research centres. Those centres in some cases connect R&D workers of various organisations from various parts of the Czech Republic, but the creation of new legal entities is still hindered by legal regulations. Also the establishment of industrial zones in the framework of regional policies facilitates the foundation of industrial R&D units with the subsequent migration of workers into them. It is a question of Philips company in Hranice na Moravě, Tesla Lanškroun or Škoda Mladá Boleslav (only the development activities).

In the sphere of career opportunities the situation has not changed markedly. There neither exist obligatory criteria of assessment of creative R&D workers, for example by attestation commissions of individual institutions, nor was the differentiation and definition of research and development positions stressing the division of creative R&D professions from service, auxiliary and other positions accomplished. It leads to the excessive overloading of the creative workers by service and auxiliary activities, reduces its productivity and influences their international competitiveness (particularly in the creative sphere).



In order to improve the migration of scientists and researchers from abroad to the Czech Republic, it is necessary to make the intra-branch co-operation of state administration bodies more intensive with the aim to implement such a migration policy which would facilitate the engagement of foreigners into R&D. An example may for instance serve the creation of the status of "a scientist" or "a researcher" for whom simplified administrative procedures for the engagement into R&D would apply.

In order to make the research work itself more intensive and quality and to increase the career opportunities, particularly in connection with the increase of attractiveness of research for young graduates, it is necessary to distinctly differentiate research and development positions and to separate creative work from the servicing, auxiliary and other kinds of work. The classification of these R&D activities should be done in compliance with the Canberra manual.<sup>4</sup>

#### To IV. 1. 5 Inter-sector co-operation

This problem is more complicated than the NR&DP of 2000 envisaged. The co-operation impinges upon the barriers in legal provisions, structure and volume of programmes co-ordinated by individual central administrative authorities, upon the shortcomings of management at all levels but also upon certain psychological barriers in approaches of R&D workers to the inter-sector co-operation.

Certain progress was achieved by some R&D programmes, particularly programmes of the Ministry of Education, Youth and Sport and the Ministry of Industry and Trade, which – through the published conditions – forced the interested parties to inter-sector co-operation (Research Centres Programme, Consortia Programme, Programmes Park, Technos).

The co-operation of universities and the Academy of Sciences of the Czech Republic has improved. In compliance with the intentions of the policy, the preparation of the participants of doctoral study programmes was facilitated in the institutes of the Academy of Sciences of the Czech Republic. Framework agreements on the co-operation of universities and the Academy of Sciences of the Czech Republic with industry and other users of R&D outputs were concluded.

Future policy should stipulate more concrete measures for the improvement of inter-sector co-operation and propose a control system and the implementation of these measures.

#### To IV. 1. 6 Regional aspects

This is also a long-term issue. More substantial changes cannot be reached within several years and they cannot be enforced by central administrative authorities themselves. R&D capacities shall remain unequally distributed over the territory of the state for many years more.

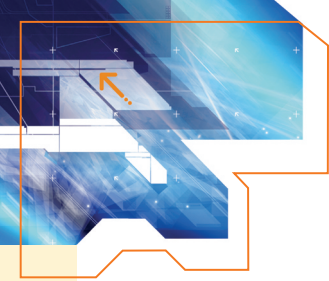
It is not possible to expect that a new National R&D Policy shall resolve everything. Also the regional policies of individual larger territorial administrative units shall have to contribute to it. Prepared Act on state-supported R&D allows to support R&D and not only from the state budget but also from the budgets of larger territorial administrative units, towns and municipalities.

National R&D Policy of 2000 imposed upon the administrators of individual budget chapters of which R&D is financed to draw up R&D conceptions of their respective resorts in connection with the policy. It will be necessary for the future policy to invite also the larger territorial administrative units to draw up regional R&D conceptions. Measures supporting regional R&D conceptions and co-ordinating national and regional policies will have to be part of the future policy.

#### To IV. 1. 7 International co-operation

International co-operation in R&D has been basically developing in compliance with the principles stipulated by the policy. It is possible to positively assess the number of projects in the solution of which R&D workplaces from the Czech Republic participate, which were included into the 5<sup>th</sup> Framework Programme of R&D Technologies of the EU. These projects passed through a very demanding and matter-of-fact public tender. The programme on the basis of which professional and regional contact organisations for a framework programme of oriented research (EUPRO) were established and work also contributes to the overall success. The INGO programme facilitates the

<sup>4</sup>) OECD Methodological manual for the assessment of human resources. Analogy to Frascati manual for the assessment of R&D.



inclusion of Czech Republic entities into various international R&D organisations. The Czech Republic has actively joined the process of creating and development of the European Research Area. On the other hand, the participation itself cannot be regarded in the future policy as a main criterion of successful participation in those programmes, but the attained results and benefits for the Czech Republic.

New R&D policy must continue to increase the stress laid on effectiveness and contributions for economy and society, particularly in case of bilateral co-operation. It is not going to be a simple process, the incorporation of foreign partners shall be necessary.

New R&D policy shall have to include also a new dimension in the sphere of international co-operation, co-ordination of R&D policy with R&D policies of other EU member and candidate countries in compliance with the Treaty on the establishment of the EC.

#### **To IV. 2 Material, thematic priorities**

As it was mentioned above, the sub-chapter on material, thematic priorities deals with, on one hand, specialisation of non-oriented research, and on the other hand, with priorities of oriented research.

##### **To IV. 2. 1 Specialisation of a non-oriented research**

This chapter deals predominantly with the sphere of basic research stressing the assessment of research work, which has an impact on the concentration of human, material technical and financial resources into a particular area.

Possible conflicts of interests were not fully eliminated from the assessment of non-oriented research. For objective reasons the assessing teams continue to be formed of research workers who themselves try to get a targeted support for their own project proposals. This problem may be solved in two ways. Either by introducing explicit and objective assessment criteria of research projects proposals and adherence to the principles of objectivity and transparency of assessing procedures, or by a more substantial modification of multiple R&D financing. This modification may rest upon the decrease of number of research projects by enlarging their volume.

The State complied with the principle of non-interference into the choice and procedures of this category of research. As regards material, professional level, this rule applies also for the future policy, but as regards rules of those procedures, it follows from the above-mentioned facts that the state must regulate this process by appropriate legal and other instruments.

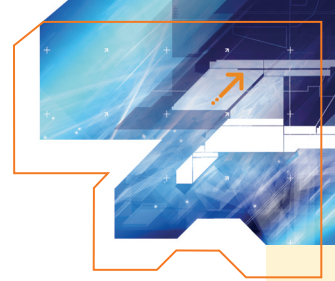
The introduction of regular, objective and independent assessment and concentration of resources into fewer problems, to which the policy invited the professional community, these processes are of a more long-term character.

Future policy should propose measures, which would speed up the mentioned processes and increase the performance and effectiveness of oriented research.

##### **To IV. 2. 2 Material, thematic priorities in oriented research**

In this part the policy stipulated the framework of the structure and manner of preparation of NOR&DP. It has been an extraordinarily difficult assignment. The appropriate bearer of the state order was found only after a repeated public tender. The assignment pursuant to the policy was basically fulfilled. Several hundreds of experts from the Czech Republic took part in the preparation of the proposal. The programme proposal has also been positively evaluated abroad.

The preparation of programme proposal was delayed for a year as is mentioned in part A of the fulfilment of tasks following from the resolution of the Government on the national policy of R&D in the Czech Republic assessment. The solution of first projects was not commenced since the beginning of 2002. If it succeeds to ensure the necessary amount of financial means, the solution of the first projects may start in the second half of 2003. More detailed work dealing with the management and



implementation of the programme showed that it will not be possible to launch the programme as a whole in one moment. It has appeared that the instant termination of existing R&D programmes and the transfer of a certain number of unfinished projects on the basis of the assessment into the National Oriented R&D Programme is legally impracticable. The programme shall start gradually, which is the case abroad.

On the basis of the evaluation of experience following from the preparation of NOR&DP, the future policy should stipulate the framework of the procedure of preparation of a new National Research Programme.

## V. Financing and support of R&D

NR&DP of 2000 has risen from the repeated obligation of the Government to reach

- in 2000, the proportion of expenditures of the state budget devoted to R&D in the amount of 0.6 % of GDP, the reality was 0.594 % of GDP,
- in 2001, the proportion of expenditures of the state budget devoted to R&D in the amount of 0.65 % of GDP, the reality was 0.590 % of GDP,
- in 2002, the proportion of expenditures of the state budget devoted to R&D in the amount of 0.7 % of GDP, the reality pursuant to the approved budget and envisaged development of GDP shall be 0.544 % of GDP

The fact that the Government did not succeed to fulfil the approved amount of expenditure of 0.7 % of GDP was criticised by the European Commission and caused that some of the NR&DP aims could not be fulfilled.

### To V. 1. 1 State and overall support of R&D

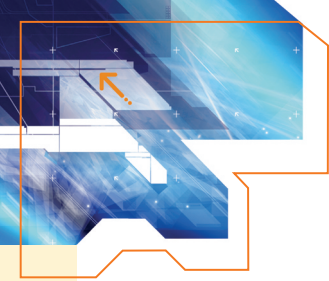
In the Czech Republic, since the half of the 1990s there has been a relatively low amount of state financial resources on the overall support of R&D. Out of the developed OECD countries, only those countries having a liberal model of economy and low expenditures on defence R&D show the portion of state expenditure on the overall expenditures on R&D in the amount slightly increasing 40 %. Countries aspiring to accede to the EU show substantially higher portion of state expenditures on R&D on the overall expenditure on R&D. It is beyond any doubt that the portion of public expenditures of the overall expenditure to R&D has been relatively strongly decreasing in recent years. At the same time, the private sector directs its expenditures on R&D into short-term commercially usable R&D. Insufficient investment into more risky but perspective hi-tech R&D technologies may result in the endangerment of competitiveness of Czech Republic economy in the future.

Maximum permissible amount of the contribution mentioned in the NR&DP was included into the Regulation of the Government No. 88/2001 Coll. in compliance with the EU directives. The above-mentioned decrease of state expenditures has negatively displayed also in case of projects financed both from the state and private sources and some of them were terminated or have not been even commenced. The strategy of synergy effects pursued by the NR&DP was ruined.

New NR&DP must seek to remedy the present unfavourable trends under which the expenditures on R&D from state sources in the Czech Republic are still more and more remote from the average of expenditures of the EU member states. New NR&DP must be based on the real, but guaranteed presumption of expenditures on R&D. The non-observance of promised state expenditures on R&D would in the time when the EU together with the associated countries strive for the creation of the European Research Area have serious international political consequences.

### To V. 1. 2 State support of R&D and its distribution

NR&DP introduced a new manner of distribution of state support of R&D – the change of so-called index method of the distribution of means to particular programmes and research plans pursuant to its quality, outputs etc.



The manner of cutting the means was as serious as the decrease of the amount of state support of R&D. In the final phases of the preparation of the proposal of state budget expenditures, a number of administrators of budget chapters preferred other priorities and decreased the expenditure on R&D. This resulted in the substantial and increasing disproportion among individual parts of research in the monitored period. The expenditures on the industrial research and development were cut most and its portion on the overall expenditures (in 2000 already quite low in comparison with developed countries) further decreased. Also the research and development at the universities were affected. At the same time, the portion of institutional means increased to the prejudice of the targeted ones. The competitiveness of R&D workplaces in Czechia (already very limited due to its volume, inadequate equipment of workplaces etc.) has further decreased due to the fact that the institutional means are not provided on the basis of public tenders. The result of these measures is exactly opposite to the trend in the developed countries. The Czech Republic retreats instead of approximates to it.

#### To V. 1. 3 Targeted support of R&D by means of a public tender

The undertaking to formulate the rights and obligations of both the contracting party of the project and the tenderers or recipients in the public tender in R&D was fulfilled both by the Regulation of the Government No. 88/2001 Coll. and a new Act on R&D support and the preparation of implementing regulations proposals. The principles and procedures applied in developed countries, which were gradually implemented in the Czech Republic since 1990, were completed by EU standards in this sphere and were incorporated in these legal standards. The legislation process in the area of R&D support from state means was thus completed for many years to come. That was the beginning of the period of gradual transfer (as the projects and plans commenced under the previous legal regulations shall terminate) in which those regulations shall be binding for R&D as a whole.

#### To V. 1. 4 R&D programmes and national R&D programmes

Gradual transfer to the programmes of a profile thematic character formulated pursuant to the socio-economic priorities, concentration of means to a fewer important programmes, larger and better interconnected projects and other research plans referred to in part V. 1. 4 was conditioned by new legal regulations to a certain extent. Since 2003 the mentioned and many other principles (e.g. approving of programmes on the governmental level as it is the case of developed countries) shall be applied in all new programmes.

#### To V. 1. 5 Institutional support of research intentions of R&D organisations

Experience gained in the first phase of assessment of research plans described in part V. 1. 5 was projected into a new act on R&D support. The introduction of inter-branch assessment is a substantial change in comparison with the research plans solved in 1999–2003.

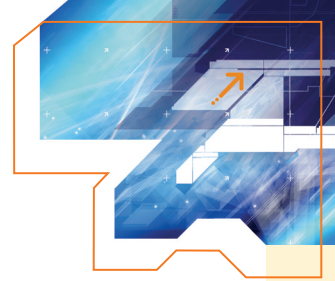
Proposals of research intentions submitted in 2003 (starting in 2004) shall be assessed by the same inter-resort commissions pursuant to a professional orientation regardless of whether they are submitted by a university, the Academy of Sciences of the Czech Republic institute or a resort research institute.

The possibility of an institutional support of non-state organisations under certain, legally strictly stipulated conditions (reinvestment of profit into R&D, prohibition to guarantee with property etc.) is another important change fulfilling the intentions of NR&DP.

Last but not least, in case of new research plans will be possible to follow not only from the assessment of quality of a given proposal as it was until today but newly also from the results attained with regard to the previous research plans.

#### To V. 1. 6 Indirect support of R&D

Although in developed countries the indirect support of R&D (i.e. tax, customs and other concessions) plays an important role not only in the R&D support but also in the implementation of its



outputs, the situation in the Czech Republic has not practically changed since 2000. A number of proposals of varied quality have been drawn up which either due to a bad timing or particularly due to a small support of those whom were these instruments addressed – private sphere, have not been projected into the relevant regulations. The key condition mentioned in NR&DP (active participation of private sphere) was not thus fulfilled.

#### To V. 1. 7 R&D management

The sphere of R&D management concerns the issue of the generation of a qualified R&D management in individual spheres of R&D including the stipulation of their scope of activity.

The solution of the need for a qualified management of activities related to R&D is a long-term process surpassing the term of validity of NR&DP 2000. The reason of a long-term realisation of a qualified management generation at all levels is particularly a gradual introduction of the corresponding framework of legal regulations. Act on R&D support concerns mainly the research management as regards the state administration and some providers of state support.

A low level of professionalisation together with the accumulation of research and administrative positions is inherent to the present state of management in R&D itself. Act on R&DI should improve this situation.

#### To V. 2. 1 Completion of transformation of resort budgetary and contributory R&D organisations

This chapter deals with the manner of transformation of resort budgetary and contributory organisations engaged in R&D. In compliance with the intentions of NR&DP, the then budgetary and contributory organisations were changed among others into the organisational sections of the Czech Republic and into the state contributory organisations by act No. 219/2000 Coll. on the property of the Czech Republic and its presence in legal relations. In case of those organisations of which research and development is a main activity, another step – their legal transformation into public research institutions (PRI) legally prepared by the Resolution of the Government No. 400/2002, shall follow.

This intention has not been successfully completed yet. At first, the Government decided a separate act shall deal with the issue of public research institutions, not act on R&D. While preparing the governmental proposal of Act on public research institutions in spring 2001, the introduction of a new legal entity (public research institution) into the legal order of the Czech Republic and the manner of transformation of non-state institutions engaged in R&D into public research institutions was doubted. The other problem was solved by the amendment of governmental proposal of act on R&D support during the discussions in the Chamber of Deputies. The problem of introduction of a new legal entity the Government solved by the cancellation of an original term of submission of the Act and by the imposition to draw up a legal analysis of possible variants of the solution of public research institutions problem. It further imposed to submit the proposal of a preparation procedure of a new legislation concerning the state contributory institutionally-supported organisations engaged in R&D.

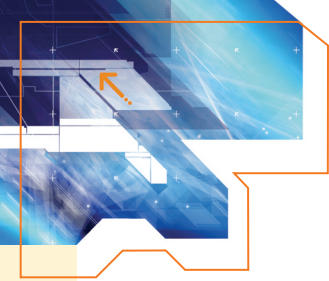
Recommendation for future policy: to draw up the bill on public research institutions and to support the transformation, particularly of the institutes of the Academy of Science of the Czech Republic and selected resort contributory research institutions.

#### To V. 2. 2 Powers and organisational arrangement of R&D state administration

NR&DP in this part characterises the shortcomings of R&D state administration, particularly in the long-term conceptual work, organisational fractionalism and insufficient quantity and quality of personnel capacities. NR&DP stated that both the structure and scope of R&D state administration in the Czech Republic are different from the majority of OECD member states. Possible solutions were set out in the following part V. 2. 3.

NR&DP envisaged that the reform of public administration on the basis of the shift of many powers from the centre to larger territorial administrative units should be used to remedy the shortco-





mings in this sphere. This assumption was not fulfilled and the capacity of R&D departments was enforced only in isolated cases.

Future policy should deal with this problem once again.

#### To V. 2. 3 R&D authorities in the Czech Republic

NR&DP in this part has stipulated two basic variants and one complementary variant. The first variant consisted of a substantial concentration of state budget means into the Ministry of Education, Youth and Sport chapter in a new organisational arrangement with sufficient personnel equipment. The second basic variant was to preserve the existing model of R&D support from a larger amount of budget chapters while concentrating the capacities engaged in the co-ordination of R&D support into a newly established Research and Development Office, which would ensure the activity of the Research and Development Council of the Government of the Czech Republic in a new structure and owing new powers. The complementary variant was to establish a new ministry for research and universities.

The Government, by its resolution approving the NR&DP, pursuing the aim to complete the variants and to choose the more appropriate one, imposed the assignment III. 4 consisting of the preparation of a proposal for the organisational assurance of state administration execution in a new R&D Act. Details see in part A of this document.

By Act on R&D support, the second variant was in fact implemented. The act fixed the powers of the Research and Development Council, Ministry of Education, Youth and Sport and other ministries and institutions in R&D, however without the necessary strengthening of personnel capacities. From time to time on various places the proposals for the establishment of the ministry for science and universities appears.

Future policy shall have to deal again with the issue of proper and effective execution of state administration in R&D.

#### To V. 2. 4 Morals and ethics

This chapter deals with the need to implement ethical viewpoints into the R&D sphere. It is important particularly in the sphere of biological and medical sciences or those sciences which deal with a biological material. Ethical issues have not been successfully resolved by the Czech Republic legislation. NR&DP envisages the establishment of ethical commissions in the relevant sciences.

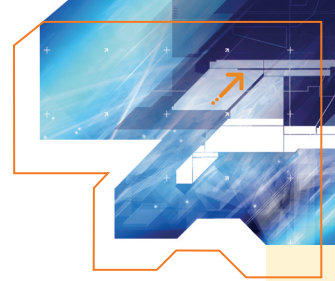
In the term of validity of NR&DP, this intention was accomplished only partially. The Bioethical Commission was established under the Research and Development Council of the Government of the Czech Republic. Its interest is at present focused on legislation.

Other ethical commissions aimed at particular sciences has not been established yet or their work is unsatisfactory.

The provisions on the protection of R&D outputs, including the protection against undesirable publishing, and right of access to the attained results, the adherence to the rules of handling with data contained in the project proposals and in projects, on the bias of opponents and members of advisory bodies were included into the act on R&D support.

The Ministry of Education, Youth and Sport invited the Academy of Sciences of the Czech Republic, the Grant Agency of the Czech Republic and the Association of Research Organisations to provide information on how the recommendation of the Government pursuant to point IV of the Resolution of the Government No. 16 of January 5, 2000 on the National R&D Policy of the Czech Republic, particularly in the sphere of morals, ethics and public relations had been fulfilled. The answers and provided supporting documents are shortly characterised below.

The Academy of Sciences of the Czech Republic places a considerable importance on the issues of ethics in research activities and its public relation and R&D management. The approach towards the mentioned matters is resolved in the fundamental aims of the Academy of Sciences of the Czech



Republic contained in the “Conception of the Academy of Sciences of the Czech Republic at the beginning of the 21<sup>st</sup> century”. These are both the adherence to the scientific and generally human ethics and providing access to and explanation of new scientific knowledge and procedures to the broad public as well as the permanent provision of existing scientific capacity to the preparation of fundamental foundations for the decision-making on important issues of the State and on the solution of the corporate problems.

The Academy of Sciences, following a broad discussion, intends to prepare and afterwards to adopt an ethics code of a researcher, worker of the Academy, which can be divided into two spheres of interest pursuant to the resources out of which the issues from the ethical point of view may follow. The first one includes the dynamic development of disciplines concerning namely life, health and personal data of people. The second one incorporates a personal approach of the researcher to research, to surrounding research community, to the provided financial support and to the handling with research outputs. Until the end of the first half of 2002, the Ethical Commission of the Academy of Sciences shall be established which shall consider and complete the thesis contained in the Conception. The first task will be the preparation of “moral code of a research worker of the Academy of Sciences of the Czech Republic”.

In the sphere of morals and ethics, the Grant Agency of the Czech Republic has published the brochure “Correct research practice” which is a recommendation defining the correct research practice across the whole range of scientific disciplines. These recommendations are based on the directives, which were published by certain EU countries, and particularly the European Science Foundation.

In the near future, the Grant Agency of the Czech Republic shall address itself to the creation of a special body, which should solve ethical problems of science, assesment proceedings and of public relations.

The Association of Research Organisations has already projected the recommendations of NR&DP into its activities. In the sphere of ethics, the General Assembly of ARO has adopted the “Ethical code of ARO members” which is available at ARO web sites. Due to the fact that the members of ARO are mostly entrepreneurial subjects, the mentioned code solves not only the issues of R&D sphere but also the issues of general inter-entrepreneurial relations. Due to the fact that the applied R&D in industry and agriculture is a fundamental branch of ARO, the issue of ethical norms concerning ethical dimension of research and use of R&D outputs is not considered to be the priority.

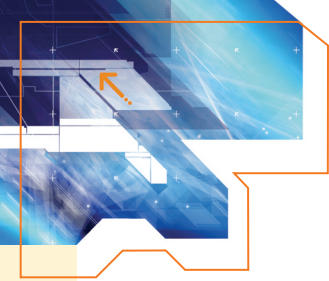
The issue of fairness in acquiring public support and public opinion on R&D is perceived as much more important. Therefore a separate chapter “Relations to state authorities and public” is devoted to these matters.

The recommendations for future policy: to increase the emphasis on the responsibility of both providers and scientists for the sphere of ethics in science and to insist on the establishment and active function of ethic commissions. It will be necessary to deal also with new aspects of morals and ethics of R&D. Recently, a number of cases on insufficient objectivity of basic research projects, the financing of which the private sector participated, has appeared. The increase of a private sector share on the R&D financing is undoubtedly a positive phenomenon, however it can apparently also bring about certain manifestation of conflict of interests of scientific truth and entrepreneurial interests.

### **To V. 3 Public, R&D in the information society**

In the Policy, the necessity of fast and effective communication among the state administration workers, organisations and R&D workers, users of their output and public was stressed. In many cases these intentions are successfully implemented. As it was mentioned, public discussions on the manner of distribution and use of means allotted to R&D are announced and the public is informed about its outputs (among others on the joint state administration web site [www.vyzkum.cz](http://www.vyzkum.cz), which is administered by the Research and Development Council and the Ministry of Education, Youth and Sport).





The obligation to inform on the use of means allotted to R&D from state funds was entrenched also into a new Act on R&D support. Likewise in the developed countries, the principle of informing the public in all cases with regard to the projects which are subject to commercial secret is anchored into it in such a manner that the public may acquaint at least with basic information on R&D implementation.

In the sphere of public relations, the Conception of the Academy of Sciences presents permanent offer of the Academy of Sciences of the Czech Republic, its professional capacities for expert and advisory activities for the state administration authorities for the solution of both the topical and long-term problems of public interest. The Conception presents also the tasks of popularisation and promoting activities, familiarisation of the public with research and development and particularly their attractiveness and meaning to the youth, which yearly takes places in the form of a popular "Day of Open Doors". It is necessary to inspire young talents to their future work in the sphere of research. One of the departments of the Secretariat of the Academy equipped by qualified public relations workers shall further pursue these problems on the level of the Academy as a whole. Information outputs are and shall be put to the Internet, too.

The Academy of Sciences of the Czech Republic is aware that the main role in the popularisation of science must be performed by individual research workplaces. It is a question of seeking the most desirable, individual forms of popularisation of research outputs in the particular branch, publishing reports in the daily press and professional periodicals, holding round table discussions, TV debates, holding press conferences relating to the most important findings etc.

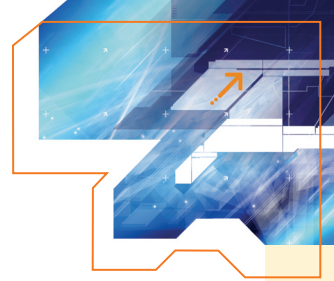
In the sphere of public relations, the Office of the Grant Agency of the Czech Republic publishes the Bulletin of the Grant Agency of the Czech Republic with up-to-date information four times a year, the list of projects which were awarded grants and the list of completed projects and their outputs and assessment of the Grant Agency of the Czech Republic. The Office administers extensive web sites of the Grant Agency of the Czech Republic, where all information on the activity of the Grant Agency is published.

On the other hand, until now most institutions and organisations lag behind in regard to relations with the public and output users. The intention of NR&DP to establish a specialised department for communication has remained unfulfilled or with the exception of rare cases these departments have failed to establish communication. To a certain extent, it is true also for the communication of the scientists themselves with public.

#### **To V. 4 Information and technical infrastructure of R&D – precondition of a modern science and research**

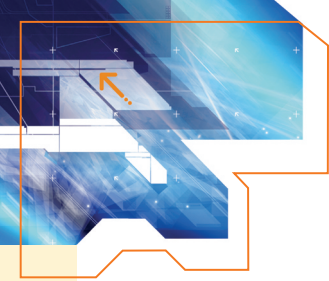
In this part, the NR&DP characterises the main shortcomings in this sphere: in technical infrastructure, instrumentation, scope, objectiveness and the recency of information resources on R&D and for R&D and in the field of libraries. It is the field of libraries, which is the worst. NR&DP considers the programmes of R&D infrastructure development support co-ordinated by the Ministry of Education, Youth and Sport the main instrument of remedy. Another instrument in the field of libraries is the co-ordination of NR&DP with the educational and cultural policy with the aim to establish the National System of Libraries.

The above-mentioned programmes contributed namely to the development of high-capacity scientific computer networks (TEN 34-CZ, TEN 155-CZ, QUANTUM, CESNET-2), to the establishment of various informational resources on and for R&D. Also the instrumentation of workplaces has improved. Gradually the information system of R&D administered by the Research and Development Council of the Government of the Czech Republic for R&D has been accomplished. The least progress has been attained in the field of libraries. Some modern information systems have been introduced into the existing scientific libraries, but the overall benefit for R&D is still insufficient. The National System of Libraries has not been established. New Act on Libraries No. 257/2001 Coll. confined itself to the defining of the system of libraries by the mere listing of libraries established by the Ministry of Culture and of basic types of libraries and their possible promoters.



The act on R&D support has eliminated the legal problems of infrastructure development support.

Future policy shall have to pay increased attention to this sphere. Properly equipped and functional infrastructure of R&D is considered by organisations abroad to be one of the basic preconditions of the whole R&D system success. .



## I. Overall assessment of the fulfilment of resort research and development conceptions of the Czech Republic of 2000

### I. ASSIGNMENT

The Resolution of the Government of January 5, 2000 on the National Research and Development Policy of the Czech Republic in point III. 3 imposed upon the members of the Government and the heads of the other central authorities and the Presidents of the Academy of Sciences of the Czech Republic and the Grant Agency of the Czech Republic to draw up and submit until April 30, 2000 to the President of the Research and Development Council of the Czech Republic the conceptions of research and development trends in the sphere of their competence and to project them into the proposal of state budget in the sphere of research and development for 2001. The assignment was fulfilled, 20 resort conceptions were submitted which were published on [www.vyzkum.cz](http://www.vyzkum.cz) except the two conceptions (Ministry of Defence and Security Intelligence Service) which included confidential data. The assignment has thus been completed for most resorts, although some of them were continually updating their conceptions. Most conceptions were discussed and approved in 2000 as the supporting documents of the budget proposal for 2001 (conceptions of the Ministry of Industry and Trade, Ministry of Transport and Communications, Ministry of Agriculture, Ministry of Health, Ministry of Labour and Welfare, Ministry of Interior, Ministry of Justice, Ministry of Culture, Ministry of Foreign Affairs, Security Intelligence Service, Academy of Sciences of the Czech Republic, Czech Safety Office, Czech Surveying and Cadastral Office, or additionally amended and completed in 2001 (Ministry of Environment, Ministry of Local Development, Ministry of Defence, State Institute of Nuclear Safety, National Safety Office, Czech Bureau of Statistics), their updating in 2002 is rather an exception (Ministry of Local Development, Grant Agency of the Czech Republic, Czech Surveying and Cadastral Office).

Both the assessment of the fulfilment of the National Research and Development Policy of the Czech Republic and the assessment of the fulfilment of the above-mentioned related resort research and development conceptions are part of the Analysis of the Previous Trends and the State of Research and Development in the Czech Republic and their comparison with the situation abroad. The Ministry of Education, Youth and Sport invited individual resorts including the Academy of Sciences of the Czech Republic and the Grant Agency of the Czech Republic to submit valid resort conceptions of R&D and the characteristics of R&D conceptions pursuant to the approved outline.

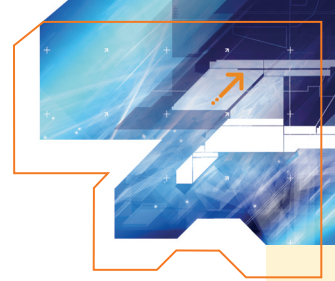
The Ministry of Education, Youth and Sport received these documents from individual resorts at the end of February 2002. On the basis of the submitted conceptions and their characteristics completed with more objective information obtained from the state budget expenditure on R&D proposals in individual years since 2001, discussions and approving of R&D programme proposals, assessment of research plans and assessment of information submitted by individual resorts into the Information System of Research and Development, the overall assessment was drawn up.

### II. OVERALL ASSESSMENT

Individual resort conceptions differ by their scope, approach and professional level of elaboration. The differences are given not only by different assignments and meanings which R&D have in the execution of powers of individual resorts but also by a substantially different approach to the conception as such.

Pursuant to the original assignment in point III. 3 of the Resolution of the Government No. 16/2000 (specified by letter of the Vice-chairman of the Government, Minister of Finance and the President of the Research and Development Council of the Czech Republic Reg. No. 7406/00-RVV of March 8, 2000) the resort conceptions should have been drawn up in the structure of the National Research and Development Policy of the Czech Republic and should have, except others, included aims and contributions stipulated in such a manner as to be concrete and assessable after the completion of the programmes. Similar requirements in a different structure for the conceptions adopted or updated in 2001 to 2002 were stipulated by the Resolution of the Government of January 3, 2001 on "Methodology of Middle-Term Conceptions".

Pursuant to the resolution of the Government relating both to the National Research and Development Policy of the Czech Republic and the Methodology of Intermediate Conceptions, each



conception should include the parts described below (it is not a prescribed structure which was besides different at the time when the resort conceptions were stipulated but mainly the material content of conceptions). National Research and Development Policy of the Czech Republic has already contained these parts (both the policy and its annexes), Methodology of Middle-Term Conceptions stipulates them explicitly.

### 1. Analysis of the situation including the comparison with the situation abroad and the fulfilment of previous assignments

Individual conceptions include this part, however it is rather a historical overview of the development, not a critical analysis of the state in the given sphere, the comparison with the situation abroad is almost absent.

### 2. Stipulation of basic aims and priorities of the development of a particular sphere

Two basic approaches are applied in individual resort conceptions:

Pursuant to the first one, the aims are stipulated generally and vaguely enough that they have a general validity and include practically everything. The absence of time limits of individual aims is typical for this type of conception. This type remains only a declaration, it is not possible to implement it in the decision-making process and it is not also possible to assess the fulfilment of their assignments.

Pursuant to the second approach, the conception is a list of individual concrete assignments known at the time of its formulation without the hierarchy of priorities and any change which must necessarily appear during the time leads to the updating of the conception. Neither of these types of conception may be used in the decision-making process.

The common denominator of both approaches is the absence of priorities or the order of importance of individual assignments which was the task which even the National Research and Development Policy did not fully comply with. Retroactively it is possible to say which priorities individual resorts had, on the basis of which they made decisions, e.g. in case of limited resources etc., but their effect was often problematic.

### 3. Conception implementation in individual spheres

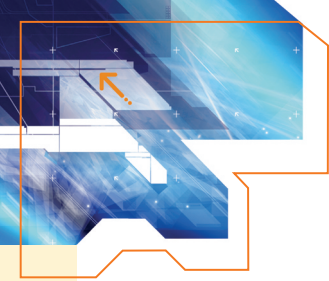
Individual resort conceptions contain a number of issues, which can be included into this part. This part includes substantial portion of what has succeeded to realise in individual conceptions at the level of individual programmes or research plans. Despite the overall positive assessment of this part, during the year in which the conception was made the necessity of fundamental changes of research and development specialisation appeared (fundamental changes of programmes, budget measures etc.) which does not indicate the feasibility of the adopted conceptions.

### 4. Co-operation – relations to the other conceptions, inter-resort and international co-operation

Although significant attention was paid to the interconnectedness of resort conceptions with other middle-term documents, the practical impact remained small. Individual conceptions are being developed in an isolated manner, the relations of resort research conceptions to the conception of the development of relevant resorts are mostly declarative. The basic shortcoming rests upon the fact that research and development is not (unlike developed countries) perceived as a necessary part of the development of a particular resort, short-term aims and measures are preferred.

### 5. Quantification of demands upon financial resources

It has appeared that the resort conceptions are less a trustworthy source of information for the quantification of demands upon the financial resources. Even if the financial means are fixed, these data are based more on the portion of the total means (see part III) than on the detailed analysis of



demands of a particular conception. A number of budget changes of a substantial character in 2000 to 2002 resulted from a erroneous conception.

#### 6. Consequences (benefits) of a conception

Besides the already mentioned Conception implementation in particular spheres it is the second part which is elaborated in detail and accompanied by many concrete data. With a view to the fact that for many reasons it is not possible to describe the conceptions as being fulfilled (see part III), the consequences of their non-fulfilment are serious and inertial (even if a change occurs the consequences in research and development display themselves only in a couple of years).

#### 7. Measures to implement the conceptions

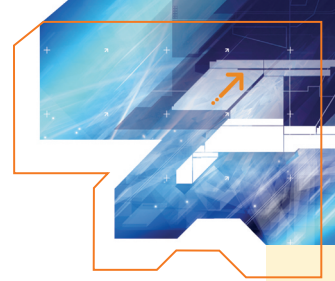
Individual conceptions practically do not contain non-legislative measures necessary to implement the conception. It appears that the demands on the increase of financial resources must be accompanied by a number of organisational and technical measures including the increase of a number of employees of the corresponding departments, otherwise these means cannot be implemented pursuant to the applicable provisions.

### III. REASONS OF NON-FULFILMENT OF RESORT CONCEPTIONS AIMS

As it was mentioned particularly in point II. 2 (Stipulation of fundamental aims and priorities of the development of a particular sphere) resort conceptions cannot be described as fulfilled and in many cases even as being fulfilled. The reasons can be summarised into several following points (irrespective of the order of importance):

1. Resort conceptions of research and development, as well as all intermediate documents, must contain parts referred to in the "Methodology of Intermediate Conceptions" approved by the Resolution of the Government No. 10 of January 3, 2001. It is possible and necessary to discuss the concretisation of some of the sub-points for the sphere of research and development but each of the above-mentioned seven parts must include the conceptions.
2. It is not sufficient to impose the elaboration of conceptions, their approval and assessment in the framework of an individual resort, particularly in the sphere of research and development their inter-resort assessment and running control of their fulfilment are necessary.
3. The shortcomings of the National R&D Policy consisting particularly in merely general stipulation of priorities negatively influenced the quality of conceptions. Despite this it is an extremely difficult task and it is not possible to expect that the resort conceptions shall concretise the priorities, which the superior conception lack.
4. The non-fulfilment of envisaged amount of state support of research and development, which should have amounted to 0.7 % of GDP in 2002 (in reality 0.54 % of GDP) has negatively affected the fulfilment of resort conceptions as well as the National R&D Policy. The mentioned difference is too high not to result, even in the case of most elaborated conceptions, in their depreciation.
5. Part of the non-fulfilment of resort conceptions is caused by the change of conditions, which could not or could hardly be envisaged. In these cases it is necessary to base a new conception on principally different bases, not to complete or modify the existing conception.

Therefore, a new National R&D Policy must also contain the assignment of ensuring the elaboration of new resort conceptions of research and development following from this overall assessment of the fulfilment of resort R&D conceptions of the Czech Republic of 2000 and implementing a new policy.



### I. Introduction

The analysis summarises information on the Czech Republic concerning research, development, science and technologies and information facilitating benchmarking of the Czech Republic in monitored areas with the European Union. The assessed information come from the organisations tied to the EU, from DG – Research and DR – Enterprise (Innovation Promotion Unit) of the European Union, United Nations Organisation bodies and multinational business organisations. On the basis of this information describing the previous development and present state of R&D including the related issues of science, innovations and technologies, the overview of strong and weak points of the Czech Republic in those sectors was drawn up. Weak and strong points were determined not only from a subjective point of view, i.e. on the bases of conclusions published in the mentioned documents, but were also implied as the reasons and consequences of the situation mentioned in the reports.

### II. Assessment on the basis of reports of multinational organisations on the Czech Republic

This part includes searches of the EU, United Nations Organisation and other institutions reports. This information related to the Czech Republic was processed with a view to elicit an idea on the viewpoint of those institutions on the standard of research and development, development of technologies, innovations and research work as such in Czechia. Besides, part B also includes the overview of benchmarking indicators of the Czech Republic in the European context. The aim is not to draw up own benchmarking study, only to summarise eligible indicators for further discussion.

#### II. A. Assessment of the Czech Republic in regular EU reports and in the Report on the Progress in the Accession Process of Particular Candidate Countries

Parts related to research and development (in reports of 2000 and 2001, research and development are featured as an independent chapter 17) are divided into the descriptive and assessment parts.<sup>1, 2, 3, 4, 5</sup> The overview of those parts is set out in Table I. While the descriptive part only mentions the most important events and quantitative research and development data of the Czech Republic in the given year, the assessment part evaluates or criticises from the EU standpoint the most relevant facts on the Czech Research Area. Although the reports agree that the Czech Republic is not expected to encounter problems in adopting *acquis* in this field or in the compliance of *acquis* with its research and development there are several areas which are criticised. These are particularly the following:

- low share of GDP allotted by the State to this sector,
- conflicts in the assurance of the state support of research and technological progress conditions between the Czech Republic and the EU,
- absence of legislation related to the public research institutions,
- improper laboratory equipment,
- insufficient support of the transfer of technologies, particularly with respect to small and medium enterprises.

However, besides the generally praiseful sentences these reports also include concrete appraisal of the Czech Republic particularly in the sphere of international co-operation where the successful engagement into the Framework Programmes is highlighted. In the previous reports, the establishment of certain new institutions (e.g. the establishment of the Grant Agency of the Czech Republic or the Department of International Co-operation of the Ministry of Education, Youth and Sport) is positively evaluated.

<sup>1)</sup> Opinion of the Commission to the Application of the Czech Republic for the Accession into the European Union, pp. 33–81 and p. 120, 1997.

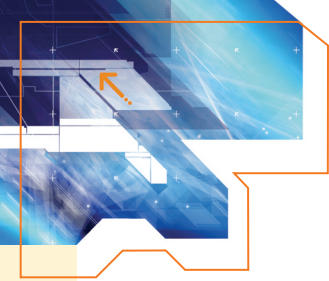
<sup>2)</sup> Annual Report on the Czech Republic of 1998, chapter 3.2, 1998.

<sup>3)</sup> Annual Report of 1999 of the European Commission on the Czech Republic – Progress in accession process, pp. 10 and 33, 1999.

<sup>4)</sup> Annual Report of 2000 of the European Commission on the Czech Republic – Progress in the accession process, pp. 10, 65–66, 2000.

<sup>5)</sup> Assessment Report of 2001, pp. 17–19, 2001.





It is mentioned in the overall document of 1999 "Report on the Progress in the Accession Process of Particular Candidate Countries"<sup>6</sup> that although the Czech Republic fulfilled the short-term priorities of the "Accession Partnership" in many principal areas, the harmonisation of legislation related to the protection of intellectual property and state support of research are not sufficiently treated. As it follows from the mentioned document, research, development and new technologies support is fundamental for the capacity to resist the competitive pressures and market forces within the Union. One of the criteria of this capacity is the amount of human resources and technical potential having corresponding costs, including infrastructure, level of education and research and future development in this field.

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### Acquis communautaire

Established term depicting a set of laws and provisions, which were adopted during individual phases of integration and common market establishment. It is used predominantly in relation to the countries, which are being admitted as new members of the EU. It means that a new country shall adopt and implement both the existing and future rights and obligations related to the system and institutional framework of the EU including the rights and obligations following from multilateral and bilateral documents signed by the EU and its member states.

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## II. B. Assessment of the competitiveness of the 75 countries for the World Economic Forum 2001

As it follows from Table II, the Czech Republic does not belong among highly competitive countries. The Growth Competitiveness Index – GCI<sup>7</sup> and the Current Competitiveness Index – CCI are the main indicators. The most alarming is particularly the decrease of the competitiveness in comparison with the previous year. The assessment of 2001 is influenced by the inclusion of new countries. Last year the Czech Republic assumed the 32<sup>nd</sup> place among the assessed countries, i.e. it is an improvement of 2 places. As regards the growth of competitiveness the Czech Republic has fallen during 2001 from the 31<sup>st</sup> to the 37<sup>th</sup> place. In 2001 the situation worsened even in comparison with the countries assessed in 2000. In this assessment it dropped to the 35<sup>th</sup> place.

## II. C. Assessment of the Czech Republic by the UNIDO and UNCTAD of the United Nations Organisation

UNIDO reports<sup>8</sup> (United Nations Industrial Development Organisation) find the defining of small and medium enterprises pursuant to the number of employees according to Act No. 229/1992 Coll. on the state support of small and medium business<sup>9</sup> functional also for business research. Besides lower tax rate for small and medium enterprises there are no financial concessions for this type of business. Research parks and innovation organisations are supported by the Ministry of Industry and Trade of the Czech Republic by means of programmes of research financing and new scientific and technological parks are established among which the report includes also the business and innovation centres (BIC) which are parts of the EBN (European BIC Network) network. Besides ten accredited parks of this type there are other four non-accredited parks and further nine are under preparation. These institutions, except others, fulfil also the training function.

UNCTAD (United Nations Conference on Trade and Development) reports mention that the foreign capital, besides the investments into the production and assembly capacities, starts to invest also into research and development. It is illustrated by the investments of a Croatian pharmaceutical company Pliva Group as well as German, French and British investments. At the same time, the report mentions the role of Czechinvest in the modernisation and other activities contributing to the development of hi-tech industry and technology transfer, e.g. co-operation with technical universities, centres of excellence establishment etc<sup>10</sup>. Czechinvest reports to which the informational

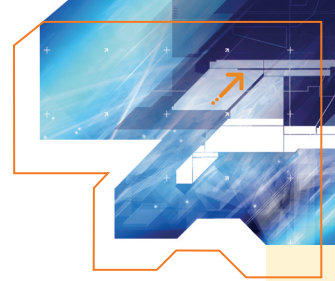
<sup>6</sup>) Overall document – Report on the Progress in Accession Process of Particular Candidate Countries, pp. 7, 19–20, 1999.

<sup>7</sup>) [www.imd.ch](http://www.imd.ch)

<sup>8</sup>) [www.unido.org](http://www.unido.org)

<sup>9</sup>) Act No. 229/1992 Coll. was revoked by Act No. 47/2002 Coll.

<sup>10</sup>) World Investment Report 2001: Promoting Linkages, pp. 114 and 189–190, United Nations, New York, Geneva 2001.



source of UNCTAD refers particularly lists the support of research and development for the purpose of innovation policy implementation and small and medium enterprises establishment. This agency refers to report 25 BIC centres including technological parks.<sup>11</sup>

## II. D. Assessment contained in reports produced upon EU commission

Upon the order of the European Commission (DG Enterprise, Innovation Directorate), contract No. INNO-99-02 the studies of innovation policy in six candidate countries including the Czech Republic were produced. Final report<sup>12</sup> on the innovation policy in six candidate countries including the Czech Republic describes the characteristic features of the innovation business in the Czech Republic. In Table III the main pros, driving forces, sources and reserves and barriers of the innovation business in the Czech Republic in the economic context including the factors influencing competitiveness of the country in the monitored period are set out. Besides, three necessary measures for the assurance of innovation enterprise were identified:

1. establishment of a creative linkage between the foreign firms and innovation institutions network,
2. setting up of the relations between the research and development base and foreign companies,
3. enlargement of an innovation spectrum of emerging technologies by the inclusion of commercial and organisational aspects.

The main characteristics of innovation policy were stipulated as follows:

- innovation policy as such does not exist in the Czech Republic, only the set of instruments contained in other policies (development of small and medium business, attractiveness for direct foreign investments, research and development policy),
- most part of responsibility for the innovation sphere rests upon the Ministry of Industry and Trade of the Czech Republic.

Pursuant to the report, the risk capital is an important investment instrument in the sphere of new technologies, e.g. information technologies and telecommunications, software etc. In the Czech Republic this source of capital has been applied insufficiently so far. In the candidate countries to which the Czech Republic belongs the structure of investments which under favourable conditions results in the industrial economy posing high demands on the competitiveness and level of knowledge is decisive for the economic changes. The restructuring of economy (production sectors and services) is the fundamental precondition of a successful passage towards the competitiveness. The restructuring processes may be substantially speeded up by means of risk capital investments into new technologies, e.g. information technologies and telecommunications, software engineering and e-services, particularly of commerce and education (e-learning, e-commerce etc.).

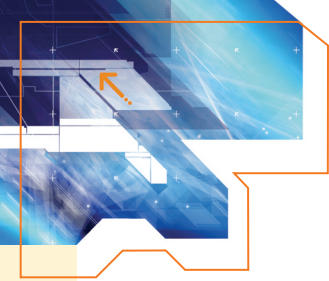
From the legal point of view there are reserves in the sphere of innovation business particularly in the registration of business activities and in the weak support of legal decision enforcement and bankruptcy proceedings. Therefore, pursuant to the report<sup>12</sup> it is necessary to establish a relevant state office with regard to this activity. The Ministry of Industry and Trade activity in this area develops promisingly, but according to the document "Innovation Policy Profile: Czech Republic" the Czech Republic lacks specific and unified innovation policy. This shortcoming is reflected in the level of success of policies related to this area, particularly of the research and development policy.

Pursuant to the mentioned final report, Czech research and development has been decentralised since the beginning of the 1990s and is characterised by a relatively large capacity of basic research mainly due to the large Academy of Sciences of the Czech Republic and the orientation of the universities on this type of research. On the other hand, industrial research depends mostly on the support of business entities which require rather short-term expert services than the outputs of systematic research. Therefore, in the national innovation system there are not only reserves in the industrially oriented research but also the sufficient support of innovation activities as well as the sufficient representation of the industrial sphere in executive bodies and organisations acting as providers of public research and development support are absent. Nevertheless the share of busi-

<sup>11)</sup> [www.czechinvest.org](http://www.czechinvest.org)

<sup>12)</sup> EC DG Enterprise, Innovation Directorate: Innovation Policy in Six Candidate Countries: Challenges CYPRUS, CZECH REPUBLIC, ESTONIA, HUNGARY, POLAND AND SLOVENIA, Final report, 2001.





ness research on the total gross expenditures on research and development (GERD) amounts to 63.1 % which is the most out of all OECD countries. The mentioned study explains these data mainly by more permanent investments into research and development and innovation by large companies, which were not affected by the problems related to the privatisation. On the other hand, only 5 % of public support were allotted to the development of new industrial products.

The foundation of new firms in the Czech Republic is rather due to the presence of foreign companies than to the stimulation by the original domestic producers.<sup>12</sup> Most of the new and highly competitive small and medium enterprises are linked predominantly to the global markets through the multinational companies established in the country.

In the "Innovation Policy Profile: Czech Republic" report on the Czech Republic the fatal impact of the privatisation process upon the industrial research and development,<sup>13</sup> the capacities of which has diminished by half (and more in some sectors) is also mentioned. In 1998, approximately 20 thousand workers (11 thousand if adjusted by full-time-equivalent) were engaged in business research and development.

As regards the patent activity, although most patent applications in the Czech Republic are filed by foreigners, domestic patents are used more extensively. The report mentions that a strained budget and restricted means on science and technologies following from it impede the Government's endeavour to adhere to its resolutions in the support of this sphere. For instance, in 2001 a part of the Ministry of Industry and Trade budget allotted to research and development was restricted by CZK 800 million which had a negative impact upon the support of research and development in small and medium enterprises.

Both the political conceptions and public opinion are oriented at the traditional support of research and development. Certain effort for the innovation policy may be found in the foundation of research centres. One of the criteria of their assessment is the industrial applicability of projects (patents, new products, new processes etc.). Pursuant to the report there is no agency which would specialise in the co-ordination and management of innovation issues in the country. The innovation indicators are studied and their implementation is planned. However, no special indicators (e.g. for the hi-tech sector) exist.

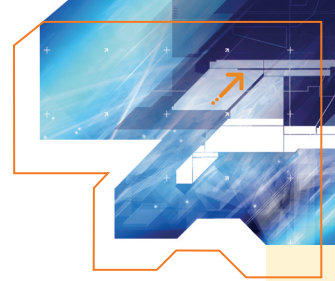
Pursuant to the report, from the legally institutional viewpoint there is no law or governmental resolution which would solve the innovation issue separately from other related policies. The monitoring of innovation policy and research and development was also the subject of Innovation capabilities of the six EU candidate countries: comparative study. It follows from this report that out of all candidate countries the Czech Republic has the lowest number of research workers per one million of inhabitants except Estonia.<sup>14</sup> On the other hand, with regard to this criterion the Czech Republic is comparable with certain member states or exceeds them (e.g. Greece has only 773 research workers per 1 million of inhabitants, while the Czech Republic has 1 222). In the sphere of scientific and technical periodicals, the Czech Republic capacity (it is fixed by the ratio of a number of scientific and technical publications to the state research and development expenditures) is low in comparison with the monitored candidate countries except Slovenia but better than in the compared EU countries (Greece, Ireland, Portugal, Spain, Denmark, Germany, the Netherlands and the United Kingdom) except Greece where the reason lies in particularly low expenditures into this sphere. If a number of scientific and technical publications is compared to a number of research and development workers, Czech Republic surpasses not only all candidate countries but also e.g. Germany or Portugal. Number of patent applications filed by the inhabitants of a particular country per 1 000 inhabitants is in the Czech Republic comparable with other monitored candidate countries, but it is lower than in most examined EU countries.

In Table IV an overview of fundamental innovation indicators for selected candidate countries and EU average are given. It follows from the available data that in comparison with other assessed candidate countries (except Estonia) and the European Union a number of university graduates in young population is relatively small. Also the workers having university education are least numerous. On the other hand, the Czech Republic, at least pursuant to the statistical data, has the most workers

<sup>12</sup> EC DG Enterprise, Innovation Directorate: Innovation Policy in Six Candidate Countries: Challenges CYPRUS, CZECH REPUBLIC, ESTONIA, HUNGARY, POLAND AND SLOVENIA, Final report, 2001.

<sup>13</sup> K. Mueller, Innovation policy in six candidate countries – Innovation Policy Profile: Czech Republic The challenges, ADE, Lovain 2001.

<sup>14</sup> T. Mickiewicz, S. Radosevic, Innovation capabilities of the six EU candidate countries: comparative data based analysis, UCL, London 2001.



engaged in hi-tech production. Public expenditures on research and development compared to the GDP are lower than in the EU and Slovenia. In 1999, business research was allotted more means than in all monitored candidate countries, however the Czech Republic has not reached the EU level. Other indicators have not been used in the Czech Republic as well as in most other candidate countries.

### III. Indicators for research and development benchmarking in the Czech Republic in the context of the European Economic Area

A new strategy of the European Union aimed at the increase of employment, economic reform and social coherence as a part of knowledge society was approved at the European Council meeting in Lisbon on March 23–24, 2000. The establishment of the European Economic Area as an integrated and co-ordinated system of research institutions in the European Union and the support of business-friendly environment for the formation and development of innovation, particularly of small and medium business form the integral part of this strategy. In the interest of the assurance of functionality and high level of the European Economic Area, both the excellence and benchmarking of the European research and development have been monitored. The Lisbon Conference has established the High Level Group on benchmarking the aim of which is to provide advisory services to the European Commission on the issues of the use of benchmarking as an instrument to improve economical competitiveness.<sup>15</sup>

Benchmarking is a methodical and systematic process aimed at the comparison of own effectiveness, quality or other level with top institutions, teams or other organisational units.<sup>16</sup> While assessing the individual EU member states as a whole the United States of America were taken as a standard to which other countries were compared. As the candidate countries have enough EU data available (except the OECD data), the EU average seems to be a natural standard for benchmarking. The European High Level Group on Benchmarking specifies the following procedure for benchmarking process:

- 1) identification of the sphere which should be improved,
- 2) stipulation of one of more indicators of the state in this sphere,
- 3) comparison of indicators between the sphere itself and the standard,
- 4) discovering of strong points and reserves,
- 5) implementation of methods leading to the elimination of reserves,
- 6) permanent monitoring of the state.

In the EU, four spheres were identified which shall be the subject of benchmarking:<sup>17</sup>

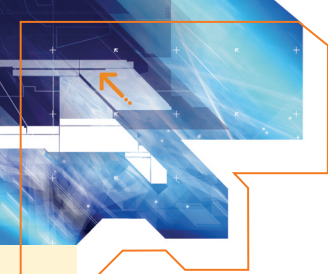
- human resources in research and technologies, including the job attractiveness in this sphere,
- state and private sources in research and technologies,
- scientific and technological productivity,
- impact of research and development upon the economical competitiveness and employment.

Indicators having a fixed data source, classification and meaning of indicators were set out for each sector. In Tables V–VIII these indicators are classified pursuant to the monitored sphere. Particular indicators proposed by the Directorate DG – Research were further modified and concretised as seen in Table IX. This table includes 40 indicators which substantially differ both from those which are monitored by OECD and those which are monitored by Directorate DG – Enterprise (see Table IV).

<sup>15</sup>) First Report by the High Level Group on Benchmarking, No. 2., European Commission, Directorate – General III – Industry, 1999.

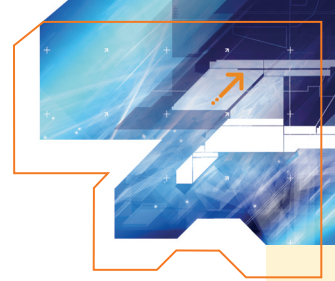
<sup>16</sup>) B. Karlöf, S. Östblom, Benchmarking, Victoria Publishing, Prague 1995.

<sup>17</sup>) Working document from the Commission services Development of an open method of co-ordination for benchmarking national research policies – Objectives, methodology and indicators, SEC (2000) 1 842.



**Table I Principal items and assessment of research and development in Annual reports of the European Commission on the Czech Republic**

Year	Report title	Principle items of the descriptive summary
1997	Opinion of the Commission to the application of the CR for the accession into the EU	Establishment of the Research and Development Council of the Government, reduction of the Academy of Sciences of the CR, establishment of the Grant Agency of the CR. Fragile relations between research and industry. Share of expenditures on university research increased to the Academy of Sciences level. General priorities of the Government in this field are intensification of university research, international co-operation and improvement of infrastructure. New legislation in the sphere of intellectual property protection and industrial rights and generally considerable adaptation of legal regulation in the sphere of intellectual property rights (patents etc.).
1998	Annual report on the Czech Republic 1998	In December 1997 the CR applied for a full accession into the Fifth Framework Programme. So far three rounds of informational dialogues took place which are the preparation of the negotiations. National programme for the adoption of Community law mentions research and development as one of the priorities. In June 1998, the Government approved a political document which is to lay bases of the national policy of research and technological development.
1999	Annual report of 1999 of the European Commission – Progress in the accession process	Closing of the research and development chapter in the negotiations on the accession. Decision of the Government to increase the state support in 2000 to 0.6 % of GDP, in 2001 to 0.65 % of GDP and a 2002 to 0.7 % GDP. In August 1999 CR became the full-fledged member of the Fifth Framework Programme (1999–2002) and Euroatom framework programme. A number of implementation structures were introduced. The Czech Republic also decided to make its relevant research activities available to the enterprises, research workers and universities of the EU member state.
2000	Annual report of 2000 of the European Commission on the progress of the Czech Republic in the accession process	The Government approved the NR&DP. This document includes the proposal for the creation of NOR&DP. In the framework of Phare assistance the relations between the top research at the universities and firms implementing new technologies are encouraged. Necessary functional administrative support and contact points were established for the Fifth Framework Programme. The contribution of the Czech Republic into this programme is fully financed from the state budget.
2001	Annual report on the procedure of the Czech Republic to the accession 2001	Progress in the implementation of NR&DP and the preparation of a new act on research and development. The governmental resolution of the targeted research and development financing was adopted. In January the central research and development register, which is financed from the state resources originated. In 2001 the Fifth Framework Programme shall be financed from state resources up to the amount of 80 %.



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### Assessment summary

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CR as one of the first European industrialised countries has a long-term tradition of research and technological development. It has made efforts to restructure the institutes. Now it will have to consolidate this sector in such a manner as to serve the industrial innovation. From the perspective of accession into the EU no substantial problems are expected. Improper laboratory equipment of research.

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Procedures and programmes in research and technologies sphere certify the progress in this sphere.

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Both the research and development programmes and policy are being further developed. Progress was made in the sphere of research and technological development by the accession to the Fifth Framework Programme.

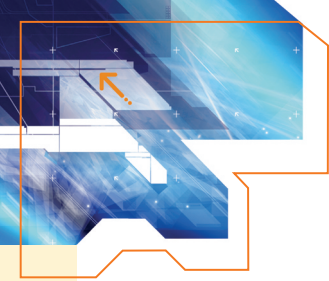
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The Czech Republic is not supposed to have problems in the adoption of *acquis* in this field. Measures to the gradual increase of financial support of research and development has been implemented. The share of the GDP allotted to this sector is low. It is necessary to ensure the harmonisation of conditions for state support of research and technological development with the corresponding EU conditions. Legislation related to the public research institutions should specify the legal status of these institutions and regulate their establishment and winding-up. Support of adopting technologies, particularly of small and medium enterprises should be strengthened.

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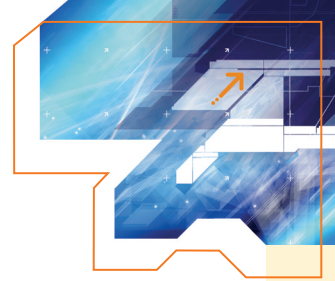
High level of compliance with *acquis*. However, the financial support of science and development continues to be relatively low. It is necessary to increase gross domestic expenditure on research and development in order to facilitate further development and functioning of the European Research Area. The legislation should harmonise the conditions for the allotment of state support with the European law as well as the legal definition of research institution should be elaborated.

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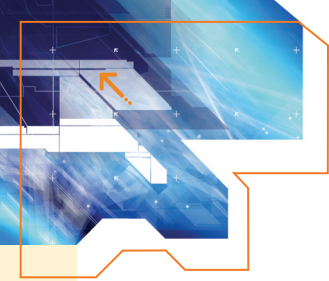


**Table II Assessment of competitiveness of the 75 countries for the World Economic Forum 2001**

Country	Competitiveness		Growth of competitiveness	
	2001	2000	2001	2000
Finland	1	1	1	5
USA	2	2	2	1
the Netherlands	3	4	8	3
Germany	4	3	17	14
Switzerland	5	5	15	9
Sweden	6	7	9	12
UK	7	8	12	8
Denmark	8	6	14	13
Australia	9	10	5	11
Singapore	10	9	4	2
Canada	11	11	3	6
France	12	15	20	21
Austria	13	13	18	17
Belgium	14	12	19	16
Japan	15	14	21	20
Iceland	16	17	16	23
Israel	17	18	24	18
Hong Kong	18	16	13	7
Norway	19	20	6	15
New Zealand	20	19	10	19
Taiwan	21	21	7	10
Ireland	22	22	11	4
Spain	23	23	22	26
Italy	24	24	26	29
South African Republic	25	25	34	32
Hungary	26	32	28	25
Estonia	27	–	29	–
Korea (South)	28	27	23	28
Chile	29	26	27	27
Brazil	30	31	44	45
Portugal	31	28	25	22
Slovenia	32	–	31	–
Turkey	33	29	54	39
Trinidad and Tobago	34	–	38	–
Czech Republic	35	34	37	31
India	36	37	57	48
Malaysia	37	30	30	24



Country	Competitiveness		Growth of competitiveness	
	2001	2000	2001	2000
Thailand	38	40	33	30
Slovakia	39	36	40	38
Jamaica	40	–	52	–
Poland	41	41	41	34
Latvia	42	–	47	–
Greece	43	33	36	33
Jordan	44	35	45	46
Egypt	45	39	51	41
Uruguay	46	–	46	–
China	47	44	39	40
Panama	48	–	53	–
Lithuania	49	–	43	–
Kostarica	50	43	35	37
Mexico	51	42	42	42
Island of St. Mauritius	52	38	32	35
Argentina	53	45	49	44
Philippines	54	46	48	36
Indonesia	55	47	64	43
Columbia	56	48	65	51
Sri Lanka	57	–	61	–
Russia	58	52	63	54
Dominican Republic	59	–	50	–
Ukraine	60	56	69	56
Rumania	61	–	56	–
Vietnam	62	53	60	52
Peru	63	49	55	47
Salvador	64	51	58	49
Zimbabwe	65	50	75	55
Venezuela	66	54	62	53
Nigeria	67	–	74	–
Bulgaria	68	55	59	57
Guatemala	69	–	66	–
Paraguay	70	–	72	–
Nicaragua	71	–	73	–
Ecuador	72	57	68	58
Bangladesh	73	–	71	–
Honduras	74	–	70	–
Bolivia	75	58	67	50



**Table III Innovation profile of the Czech Republic pursuant to the EU DG-Enterprise**

#### **Positive sides**

- favourable legislation and liberal environment for the establishment of new companies
- strong industry in sectors implementing highly intensive technology
- growth of hi-tech sectors
- fast growth of direct foreign investments since the half of the 1990s
- decrease of the tax burden on the society
- orientation of the country to extensive export

#### **Reserves**

- growth of unemployment
- unsuccessful privatisation of large enterprises
- dynamically developing sector of small and medium business is absent
- lag of competent institutions reform
- non-diversified and variable framework of regulative mechanisms of the assurance of the functionality and expansion of companies

#### **Innovation driving forces and resources**

- tradition of co-operation in industrial production
- direct foreign investments play an important role in the increase of knowledge of workers
- reasonable offer of training programmes for the innovation management co-ordinated by the Association of Innovation Business of the Czech Republic,
- relations between science and industry by means of the participation of industry workers in universities activities and joint academic and industrial research centres exist and are being further strengthen
- institutes of industrial research financed from contracts
- positive indirect role of non-governmental organisations (public discussions, increase of knowledgeability)
- increase of risk capital

#### **Innovation barriers**

- innovation is limited to the technical development only
- expansion of innovation technologies of foreign firms is limited due to the fragile relations with domestic firms
- insufficient linkage between industry and academic community

#### **Main political initiatives in favour of innovations**

##### *New organisations in support of the innovation infrastructure*

- research centres at universities, consortia among the Academy of Sciences of the CR and industrial research and development
- construction of industrial zones with a view to increase the attractiveness for foreign investors
- business entities at the universities
- regional consultant and information centres

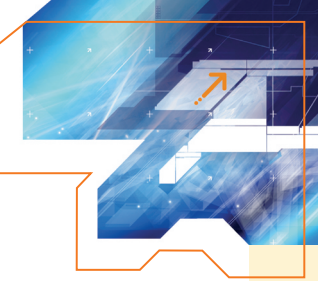
##### *Programmes and other instruments supporting innovation business*

- support of industry restructuring by means of loans for the development of business and for the activity of Revitalisation Agency,
- support of sub-contracting activities and co-operation among companies
- introduction of criteria of industrial contribution into the assessment of results of research from state resources
- CONSORTIA Programme
- domestic research and development programmes
- increase of autonomy of higher education institutes and improvement of possibilities of their tie to industry

#### **Political assignments**

- establishment of integrated political framework
- development of legal framework favourable for the creation of links in the system as well as the effectiveness of spin-off companies
- stimulation of new firms establishment
- transfer from the institutional to project (i.e. targeted) support
- insurance of budgetary resources for the implementation of innovation policy
- introduction of stimulating tax policy for research and industry and the innovation activities

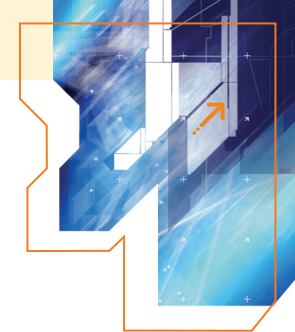




**Table IV Principal innovation indicators of the EU in comparison with the candidate countries pursuant to the EU General Directorate – Enterprise**

No.	Indicator	Year	Cyprus	CR	Estonia	Hungary	Poland	Slovenia	EU
<b>Human resources</b>									
1.1	Univ. graduates/population 20–29 years (‰)	1999	–	4.0	3.8	5.5	5.9	13.1	9.32
1.2	Share of active university graduate population (%)	1999	22.60	11.30	40.80	15.60	14.80	15.90	23.25
1.3	Life-long education	–	–	–	–	–	–	–	9.65
1.4	Share of employees in hi-tech production (%)	1999	1.85	10.63	5.71	8.49	7.54	10.18	6.29
1.5	Share of employees in hi-tech services (%)	–	–	–	–	–	–	–	3.27
<b>Formation of knowledge</b>									
2.1	State expenditures R&D/GDP (%)	1999	0.18	0.47	0.48	0.37	0.44	0.64	0.62
2.2	Business expenditure R&D/GDP (%)	1999	0.03	0.82	0.12	0.26	0.30	0.75	1.14
2.3 a)	EPO h-tech patenty /number of inhabitants	–	–	–	–	–	–	–	–
2.3 b)	USPTO hi-tech patents /number of inhabitants	1998	0	0	0	2.08	0	1.52	11.65
<b>Transfer and use of knowledge</b>									
3.1	% of SME* with own innovations	–	–	–	–	–	4.1	16.9	41.01
3.2	% of SME innovating in co-operation	–	–	–	–	–	–	–	15.42
3.3	Innovation costs/total sale	–	–	–	–	–	4.1	3.9	3.41
<b>Innovation financing, performance and market</b>									
4.1	Risk capital/GDP (%)	1999	–	0.021	–	0.016	0.045	–	0.09
4.2	New capital/GDP (%)	1999	–	–	–	–	0.24	0.15	1.53
4.3	Share of new products on the market (%)	–	–	–	–	–	–	–	5.40
4.4	Access to the Internet at home	–	–	–	–	–	–	–	33.40
4.5	Share of ICT market on GDP (%)	1999	–	8.49	–	6.42	4.9	4.31	5.86
4.6	Share of hi-tech products on trade in 93–97	–	–	–	–	–	–	–	9.50

\*J SME – Small and Medium Enterprises

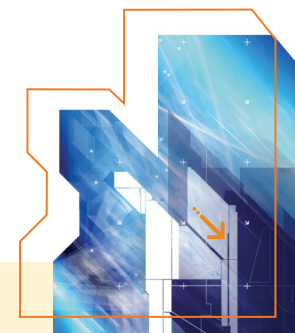


**Table V Human resources of R&D including the attractiveness of jobs in this sphere**

Indicators	Source	Classification	Importance
Number of researchers in relation with the total number of workers.	Eurostat/OECD/ member states	Classification pursuant to industry, universities and public research centres on one hand and pursuant to sectors on the other hand.	Measure of R&D workers number in particular countries. It is necessary to ascertain how the data of individual countries are mutually comparable.
Number of new doctors (Ph.D.) in science and technologies in relation to the number of population of the same age.	Eurostat/OECD/ UNESCO	Classification pursuant to the sectors including social and economic sciences. Classification pursuant to the country of origin.	Increase of highly qualified base of working force.
Number of young researchers engaged at universities and state research institutions in relation the total number of researchers.	New indicator	Ascertainment of an average age of workers holding a particular position. Share of workers retiring in the next 10 years. Salary classification.	Reflects the attractiveness of science for young people and perspective of the maintenance of education-based economy.
Share of women on the total number of researchers at universities and state research organisations.	New indicator	Classification pursuant to the responsibility of the position held.	Implies the share of women in science and their contribution to the knowledge development.
Share of foreign researchers at universities and state research centres.	New indicator	Classification pursuant to the country of origin. Data on the participation of these workers in European programmes.	Reflects the international attractiveness of national scientific systems and is a measure of "knowledge diffusion" from the outside.

**Table VI State and private expenditures on R&D**

<b>Indicators</b>	<b>Resources</b>	<b>Classification</b>	<b>Importance</b>
Total expenditures on research and development related to the GDP.	Eurostat, OED, member states	Classification pursuant to the provider (resort). Classification on the basic and applied research.	Measure of economic perspective of the provision of R&D support.
Industrial expenditures on research and development. Share of R&D in industry financed from public resources.	Eurostat, OECD, member states.	Classification pursuant to industry sectors.	Measure of relative importance of expenditures on R&D of business sector in economy as a whole. State support of industrial R&D.
Share of state R&D expenditures in the budget.	Eurostat, OECD, member states.	Division of the budget allotted to research pursuant to the aims of R&D policy. Funds earmarked for R&D policy support. Classification of the budget allotted to R&D pursuant to the principal sectors (e.g. civil and defence).	Measure of what importance the Government places on R&D while distributing public resources.
Share of small and medium enterprises (SME) in R&D financed from state sources but conducted in business sphere.	Data are not fully statistically processed.	Share of SME on business subjects engaged in research.	Measure of state support of research in SME.
Volume of risk capital invested in initial phases of business (e.g. establishment of a new enterprise) related to the GDP.	EVCA, NVCA, AVCA, member states (unprocessed data).	To find how to improve data comparability. Share of risk capital in hi-tech industry.	Indicator of financing new firms with a large scale of innovation.



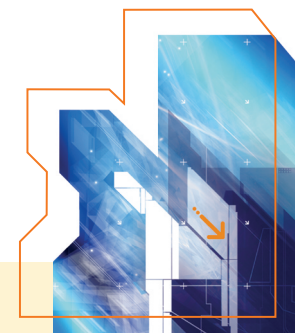


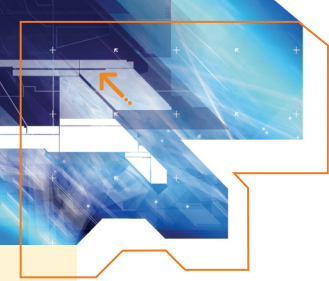
**Table VII Research and development performance**

Indicators	Sources	Classification	Importance
Number of patents applied for at the European Patent Office and US Patent Office.	EPO/USPTO	Share of patents in hi-tech spheres. Implementation of other quantitative factors as assessment criteria (e.g. expenditures on business research, share of researchers).	Measure of implementation of technologies in a particular country.
Share of scientific publications and the most commonly cited publications per capita.	Science citation index	Classification pursuant to scientific topical spheres (together with the examination of possibilities of social and human sciences inclusion). Implementation of other possible quantitative factors as assessment criteria (e.g. expenditures on R&D into the non-business sphere, numbers of researchers etc.). Share of publications from multiple workplaces on the overall number of publications of a particular country.	Measure of research work and co-operation.
Number of spin-off enterprises originating from universities and research centres	New indicator	Indicator of spin-off enterprises functioning. Implementation of other possible quantitative factors as assessment criteria (e.g. per capita, GDP etc.).	Measure of development of new economic activities of R&D workers.
Percentage of innovation companies co-operating with other firms, universities or public research organisations.	Eurostat	Other (i.e. except spin-off) forms of co-operation between universities and industry.	Implies possible ways of co-operation contributing to the strengthening of literacy and innovation transfer.
Level of implementation of wide frequency band of electronic networks in research.	New indicator	Necessity of methodology examination.	Measurement of degree of interconnection and use of electronic research networks – the larger and better connection the more probable is the increase of both quantity and quality of research outputs and the quicker the mutual diffusion of technologies and R&D outputs.

**Table VIII Impact of R&D upon the competitiveness of economy and employment**

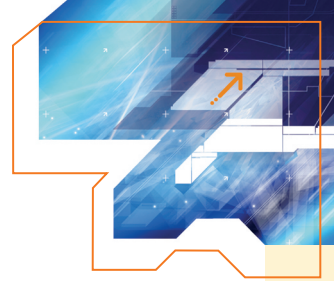
Indicators	Sources	Classification	Importance
Rate of growth of labour productivity.	Eurostat /OECD/ member states	Growth expressed in absolute productivity indicators. Growth of rate of labour productivity in: ■ hi-tech firms, ■ medium-tech firms, ■ low-tech firms.	Measure of the overall competitiveness of economy. Reflects economic influences induced by innovation and scientific-technical progress.
Share of hi-tech and medium-tech industry in employment and domestic product.	Eurostat /OECD/ member states	Classification pursuant to sectors (including contributions of ICT sector).	Implies the contribution of hi-tech (and medium-tech) sectors into economic growth and employment.
Share of qualification-demanding services in production.	Eurostat /OECD/ member states	Classification pursuant to individual sectors.	Measure of contribution of qualification-demanding services to employment and production potential.
Volume of transfer of means in the sphere of technologies in relation to VAT.	Eurostat /OECD/ member states	Classification pursuant to the transaction type. Classification to domestic and international payments (analogy to intra-EU or extra-EU). Examine how to re-define indicators for scientific-technical purposes.	Measures the importance of state incomes from research, development and technologies outputs and technological services export (including licences, know-how, trademarks, technical services etc.).
Growth of the share of the country in hi-tech products export.	Eurostat (Comext)/UN (Comtrade)	Classification pursuant to the type of products.	Implies the changes in international competitiveness in hi-tech products.





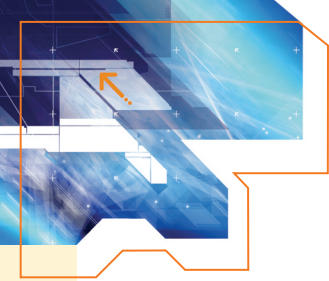
**Table IX Real indicators introduced by the EU for the benchmarking**

Indicator	EU	USA	Japan	Finland
1.1.1. Share of researchers per 1 000 workers	5.28	8.08	9.26	10.62
1.1.2. Share of growth of the number of researchers since 1995	2.89	6.21	2.57	12.68
1.2.1. Number of researchers aged 25–34 engaged into employment at universities and in state research institutes per 1 000 inhabitants	0.55	0.47	0.24	0.97
1.2.2. Growth of the number of new doctors (PhD) 1998–1999	0.37	0.63	0.74	-4.51
2.1.1. Expenditures on R&D/GDP (R&D intensity)	1.92	2.62	2.91	3.30
2.1.2. Average annual growth of expenditures on R&D since 1995	3.03	5.55	4.13	13.02
2.2.1. Industrial expenditures on R&D as a share of industrial production	1.42	2.08	2.49	3.18
2.2.2. Average annual growth of industrial expenditures on R&D since 1995	4.86	8.21	4.60	17.51
2.3.1. Share of state expenditures on R&D	1.99	4.20	3.86	2.11
2.3.2. Annual growth of expenditures on R&D since 1995	0.61	1.48	6.26	4.99
2.3.3. Share of civil research in the overall state expenditures on research and development	85.52	50.00	95.90	98.70
2.4.1. Share of SME in public support of business sector (%)	–	10.01	15.45	48.41
2.4.2. Annual growth of public support of SME (%) since 1995	–	12.15	19.71	14.03
2.5.1. Risk capital for the establishment and start of a new business activity	0.38	1.16	0.99	0.56
2.5.2. Annual growth of capital in % for the establishment and start on a new business activity since 1995	69.99	46.88	44.87	70.80
3.1.1. European patents per 1 mil inhabitants in 1999	125	130	126	265
3.1.2. Annual growth of European patents since 1995	11.72	12.38	9.62	14.79
3.1.3. Number of US patents per 1 mil inhabitants in % in 1999	69	312	248	129
3.1.4. Annual growth of US patents since 1995 in %	9.93	8.96	7.56	12.45
3.2.1. Number of research publications per 1 mil inhabitants	613	708	498	1157
3.2.2. Annual growth of publications in % since 1995	2.92	-0.08	4.26	4.92
3.2.3. Number of frequently cited publications related to the overall number of publications	1.20	1.27	0.65	1.25
3.2.4. Number of frequently cited works in one year (for the year in which data were available in the period)	11495	13566	1520	257
3.2.5. Number of frequently cited publications per 1 mil inhabitants	31	50	12	50
3.4.1. Percentage share of innovation firms co-operating with other firms, universities or research institutions	25	–	–	70
3.4.2. Share of turnover corresponding to a new or innovated product proceeded from the co-operation (see 3. 4. 1)	50	–	–	95 (estimate)
4.1.1. Productivity of labour (GDP/1 hour of work) in purchase power parity	31.4	33.9	29.1	30.1
4.1.2. Average growth of productivity of labour since 1995 in %	1.07	0.63	1.77	2.04
4.2.1. Share of added value in hi-tech sectors in the overall production	–	8.08	10.42	8.89
4.2.2. Share of employees in hi-tech sectors in the total number of employees	7.71	5.30	6.24	7.23



Indicator	EU	USA	Japonsko	Finsko
4.3.2. a) Share of highly-qualified services in the overall employment	31.71	–	–	37.41
4.3.2. b) Growth of share of highly-qualified services in the overall employment since 1995	1.74	–	–	0.10
4.4.1. Share of incomes from the sale of technologies as a share of GDP (%)	–	0.39	0.19	0.08
4.4.2. Growth of share of incomes from the sale of technologies as a share of GDP (%) since 1995	–	3.03	14.89	29.16
4.4.3. Payment balance (export-import) in the trade of technologies as a share of GDP (%)	–	0.25	0.09	-0.24
4.5.1. Share in the world export of hi-tech products	35.73	19.75	9.95	0.83
4.5.2. Growth of share in the world export of hi-tech products since 1995	0.91	0.89	-8.48	6.41
4.5.3. Share of hi-tech products export outside internal EU market (%)	18.49	25.04	12.62	–
4.5.4. Growth of share of hi-tech export outside internal EU market in % since 1995	0.45	1.29	-8.13	–





#### **IV. Strong and weak points of research and development and of the related spheres in the Czech Republic.**

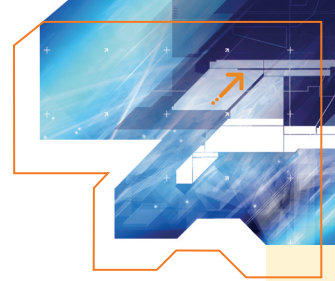
Positive sides, reserves and other typical features of the Czech Republic in the sphere of research, development and innovations were shown in the Table III "Innovation profile of the Czech Republic". This table includes directly a set of features subjectively perceived by experts working for the EU. The following overview of weak and strong points expresses the most important features of the Czech Republic in the monitored sphere seen from the outside.

##### **IV. 1. Weak points pursuant to the mentioned sources**

- insufficient state financing of research and development,
- absence of legal definition of public research institutions,
- legislative protection of intellectual property protection,
- small capacity to resist the competitive pressure and market forces of the EU with a view to the technological lag,
- insufficient transfer of technologies,
- insufficient structuring of science policy and its insufficient implementation on lower levels,
- excessive geographic centralisation of research and development and weak role of regions,
- insufficient acknowledgement and support of prognostic stipulation of research priorities,
- drastic reduction of industrial research in 1990–1993,
- weak economic competitiveness and slow growth of competitiveness of the Czech Republic,
- insufficient financial relief for innovation activities of small and medium enterprises,
- absence of innovation policy as such, only its inclusion into other policies (research and development policy etc.),
- small share of risk capital in the country,
- obsolete division of competencies of individual administrative bodies in the sphere of innovation,
- reserves in the registration of business activities,
- excessive dimension of basic research,
- small role of traditional domestic producers in the stimulation of research and development,
- influence of privatisation upon the industrial research,
- limitation of advance agreed public expenditures on research and development in individual budget chapters,
- low portion of university graduates in young population,
- low portion of university graduated researchers,
- insufficient amount of monitored data for the stipulation of indicators of research and development policy.

##### **IV. 2. Strong points pursuant to the mentioned sources**

- minimal problems with aqis adoption in the sphere of research and development,
- active international co-operation in research and development,
- satisfactory participation in the EU Framework Programmes,
- establishment of certain institutions supporting research and development,



- fulfilment of fundamental short-term priorities of “Accession Partnership”,
- meaningful use of Phare means facilitating the linkage between research and industry,
- constantly improving introduction of foresight technology and other prognostic methods,
- important role of non-state providers of research and development support,
- mass escape of experts abroad did not occur,
- establishment of technological parks, BIC etc.,
- certain attractiveness of domestic research for international investors in the spheres demanding on qualified-work force,
- positive role, particularly in increasing the awareness, of certain state organisations, e.g. Czechinvest,
- establishment of research centres,
- monitoring and study of innovation indicators by competent bodies,
- large number of scientific publications related to a number of researchers,
- large number of technical publications related to a number of researchers,
- active participation of the CR in the establishment of the European Economic Area,
- large number of employees in hi-tech spheres,
- large portion of the information and communication technologies on the GDP creation.

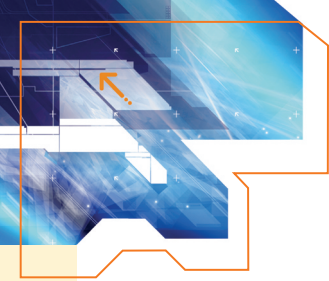
## V. Analysis of foreign reports assessment

### V. 1. Analysis of research and development legislation

Legal shortcomings in the sphere of state support of research and development and protection of research and development outputs mentioned above have already been regulated by Act on research and development support. Act No. 130/220 Coll. solves in detail the conditions of the support (Title III) and public tenders in research and development (Title V) including the stipulation of a subject matter and manners of support (Title II). Rights to the research and development outputs and their use are regulated by § 16. Also still valid Regulation of the Government No. 88/2001 on the conditions of targeted research and development financing and the transfer of data into central evidence of projects financed from the state budget, as amended by Regulation of the Government No. 374/2001 Coll. defines the conditions of a state support of research and development.

Criticised obsolete division of competencies was updated not only through the Act on research and development support (Title VIII) but also in the Status of the Research and Development Council of the Government of the Czech Republic (annex to the Governmental Resolution of June 13, 2001 No. 589) and the Status of the Grant Agency of the Czech Republic (Annex 2 to the Governmental Resolution of June, 13, 2001 No. 590). However, the contemporary conception of the decentralisation of research and development bodies does not limit the risk of decrease and re-allocation of means originally allotted to research and development. Also the reasons of insufficient implementation of research and development policy at lower levels may be found in the excessive decentralisation of research and development administration. Both the appropriate structuring of scientific policy and its implementation on the level of research organisation may be successfully implemented through the general conception of research and development progress which shall replace the sector interests.

Protection of intellectual property rights was improved by Act No. 86/1996 Coll. amending Act No. 247/1990 Coll. on literal, scientific and artistic works (Copyright Act) and a new Copyright Act No. 121/2000 Coll. The Annex to the Resolution of the Government No. 330 of April 14, 1999



“Measures aimed at fighting the delinquency in the sphere of intellectual property” including fourteen sub-sections was an important step in this sphere. This annex defines the inter-sector conception of the fight against delinquency in this sphere.

Though the above-mentioned absence of innovation policy is true it is not possible to define and implement it in the framework of research and development policy. The innovation policy is a policy tightly related to research and development policy and must be effectively co-ordinated with it. The persistent shortcoming is an insufficient legal definition of public research institutions. The preparation of a bill on public research institutions was invoked by the Resolution of the Government No. 900 of September 12, 2001 on the amendment of procedure of the preparation of a bill concerning state research institutions. It was decided to carry on a legal analysis of possible variants of solution and to submit the Government the proposal of procedure of transformation of public contributory organisations engaged in research. The analysis was completed and the Government by its Resolution No. 400/2002 imposed upon the Research and Development Council to elaborate in cooperation with the Ministry of Education, Youth and Sport and the Academy of Sciences of the Czech Republic the subject matter of Act on public research institutions and to submit it to the Government until November 2002.

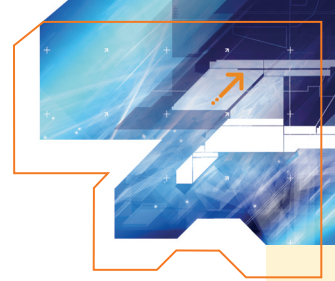
## V. 2. Analysis of human resources

As it was mentioned in the previous chapters, due to the privatisation processes in the 1990s the employment basis in research and development decreased to one half. Other sources<sup>18</sup> published by the Economic and Social Strategy Council of the Government of the Czech Republic claim that this decrease was even deeper. As one of the most important reasons of this process is the restructuring of industry and economy, it is possible to expect that also in the sphere of industrial research a number of vacancies shall gradually increase. In compliance with the described stimulation of this research predominantly by societies connected to multinational capital it is possible to expect that this increase will be linked with the migration of research workers mainly into newly established industrial zones (e.g. Philips in Hranice na Moravě) or into already restructured companies (Interpharma Praha, Dental Praha). Absorption of originally state research institutions of applied research by industrial enterprises is a specific variant (e.g. entry of VÚFB into the company Léčiva).

However, the increase of the number of research and development workers may be to the detriment of other employees of a company (AVX Lanškroun). The engagement into industrial research in the Czech Republic is often accompanied by a long-term training abroad (e.g. Philips in Eindhoven, Interpharma in San Diego etc.) which should result in the increase of qualification of those workers. The present increase of pedagogical workers at universities mentioned in part B 1 makes one possible to consider that the researchers were transferred to universities. These cases are very rare, even though such a migration from industry into specific research at universities would definitely enrich this sphere. Migration of workers into industrial research is often linked with the regional policy as this policy supports the development of business in the region, for instance by already mentioned construction of industrial zones. Therefore in the short-term horizon the project in the framework of the National Oriented Research and Development Programme shall play an important role as particularly the sectional programmes “Human Resources for Research and Development” and “Regional and International Co-operation” are devoted to these problems.

It was mentioned above that the Czech Republic was not affected by a massive “brain drain”. These conclusions are probably influenced by the data referring to the last 10 years. It is not possible to see the reasons of minimal departure of experts abroad in their good social position and satisfactory working conditions but it must be sought in their low competitiveness and/or adaptability on the international labour market in this sphere, and probably also in certain psychological barriers. Generally it is possible to say that the competitiveness of research in the Czech Republic assessed by bibliometric indicators, number of patents and contribution to the competitiveness of products, technologies and services in hi-tech sphere is lower than the EU average. On the other hand, it is necessary to mention that the principal brain drain of experts (e.g. experts having a substantial practice, occupying managerial positions, not young scientists seeking fellowships) from the Czech Republic started immediately after the social changes in 1989–1992.

<sup>18)</sup> Intermediate Conception of Social and Economic Development, Social and Economic Strategy Council of the Government of the Czech Republic, January 2000 ([www.vlada.cz/1250/vrk/rady/ses/ses.il1.shtml](http://www.vlada.cz/1250/vrk/rady/ses/ses.il1.shtml)).



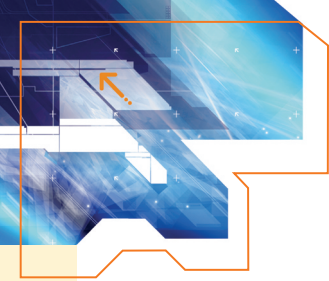
### V. 3. Competitiveness, technology foresight and research and development benchmarking

As it follows from Table II, the competitiveness and growth of competitiveness of the Czech Republic are outdistanced not only by the EU average but – except Greece – are considerably lagging behind its weak members. It is necessary to make an assessment on the bases of criteria of all important spheres including research and development to fulfil the minimal level of competitiveness in the principal sectors of economies of weaker EU countries. It will also be necessary to evaluate future progress to be able to answer the question whether the firms in individual candidate countries (it means also in the Czech Republic) shall be provided sufficient support for the adaptation to conditions and pressures of the EU. Except human and physical potential, safety, infrastructure and state administration it is a question of education and research. Therefore the measurement of competitiveness in the sphere of research and innovation is linked with human resources, policy and administration in the sphere of research, financing and infrastructure of research and development.<sup>19</sup> The improvement of the situation in these spheres shall result in the growth of economic competitiveness of the Czech Republic. The stipulation of appropriate indicators is essential for the measurement of competitiveness.

The assessment of competitiveness in the sphere of research and development is dependent on the stipulation of appropriate indicators. EU General Directorate for Research has elaborated 40 indicators mentioned in table IX. Besides, there exist 18 more indicators of the EU General Directorate – Enterprise, see table IV. Most of these indicators differ from those monitored by OECD not only by its relative nature (they are related for instance to the GDP, number of workers etc.) but they often also produce new information. Due to the fact that the data of the Czech Bureau of Statistics are compatible only with OECD, it is possible to expect that the benchmarking of research and development policy in the Czech Republic with the European Union would not be – according to the majority of criteria mentioned in table IX. – fully valuable. The same holds true – although to a lesser extent – for DG-Enterprise indicators in the table IV. Therefore it is essential either to extend the information spectrum of the Czech Bureau of Statistics in the sphere of research, innovations, hi-tech products etc. or to insure the acquisition of the mentioned data for the needs of research and development policy in a different manner (via other institutions, purchase of complete databases etc.). The benchmarking of the Czech Republic and the European Research Area would be challenging not only for the Czech Bureau of Statistics but also for the Ministry of Education, Youth and Sport, Industrial Property Office, Ministry of Industry and Trade and other state administration bodies. The non-existence of indicators for hi-tech sector mentioned in section B4 is not unusual even in the EU. Besides, this sphere belongs rather to the competence of patent offices than into the innovation and research policy. However, the outputs of the European Patent Office are inappropriate for the needs of benchmarking of Czech research in the European context as they mostly characterise the contract countries as a whole and compare them with Japan, USA etc.

Besides benchmarking which represents the improvement of the present situation and proposal of solutions for short-term future, the fundamental issue for the development of the sphere of research and innovation business is the prediction of middle- and long-term (over 10 years) trends in the sphere of technologies development (technology foresight). By introduction of sophisticated methods of prognoses elaboration (Delphi, future scenario, KCT, expert panels etc.) it is possible to optimise research and development base and to concentrate the research potential into the key assignments having the chance to be successfully coped with. As it follows from chapters B 1 and B 2, particularly the fact that the Czech Republic began predicting the trends in the development of technologies, research and development is highly evaluated. On the other hand, further development of this sphere is expected in the future. “Technological foresight” was implemented for the first time in the Czech Republic while preparing the National Oriented Research and Development Programme in 2001 and its methodology approached most the work of an expert panel. The aim was the selection of priority directions of oriented research and development and proposal of management of a new national programme and ways of transfer of existing programmes of oriented research and development into a new national programme. The increased claims on outputs during further rounds of periodical foresight of these development trends shall undoubtedly require the introduction of other methods of technological, research and development prognosis as well as balance of the composition of respondents in panels.

<sup>19</sup>) [www.euroskop.cz/euroskop/site/eu/dokumenty/Age2000.doc](http://www.euroskop.cz/euroskop/site/eu/dokumenty/Age2000.doc)



#### V. 4. Financing of research, development and innovation business

Large number of suggestions related to this sphere were summarised particularly in the assessment materials in the framework of DG-Enterprise contracts<sup>12-14</sup>. Growth of risk capital in the country is considered in these materials to be the driving force of the development of innovation business. Although there are certain parallels between the existing providers of public support and risk capital sources<sup>20</sup> (organisations supported by the Government may be investors in both cases, limited decisive powers characterise both the investors of risk capital and present providers etc.), there is a number of unsolved issues. Individual subjects in the sphere of risk innovation business or research and development business, i.e. investors, funds, innovation "enterprises" as such (i.e. research institutions, innovation companies etc.) are not defined and first of all the role of the administrator of the established risk capital fund is totally mysterious. Present legislation in the sphere of research and development is hardly applicable to this sort of innovation business. Following from the experience of non-applicability of Act No. 199/1994 Coll. on the public tender on the sphere of research and development it is possible to expect similar difficulties in the attempt to apply general acts on small and medium business support or other legislation concerning these issues on the specific sphere of research, development and innovations. The other problem is a linkage of competencies of present state administration bodies responsible for research and development with newly established subjects. The role of natural persons, both in the function of "commercial angels" and managers having the right of repurchase is very unclear. Nevertheless, both the foreign experience and the claims laid on the quality of domestic research, development and innovation base (including the transfer of technologies) in principal certify the viability of this approach.<sup>21</sup>

#### State of foreign investments (world and the most important investors) in the Czech Republic into research and development as of December 31, 1999 (in CZK thousand).<sup>22</sup>

Country	Basic capital	Re-invested profit	Other capital	Total
World	206 303	69 572	55 707	331 582
USA	56 265	-1 563	0	54 704
Germany	75 720	40 260	55 702	171 687
France	59 443	8 713	0	68 156
Australia	2 214	0	0	2 214
Sweden	12 751	22 161	0	34 912

Direct foreign investments which do not have to be necessarily concentrated into the sphere of education are another mentioned driving force of innovation. Table X. summarises foreign investments in the Czech Republic allotted into research and development. It includes both the world investments and the most important investors. It is obvious from the table that the largest investor is Germany having also the largest portion of re-invested profit.

The annual EU reports naturally monitor the development of funds devoted to research and development from state sources very carefully. A high portion of mandatory expenditures, i.e. expenditures fixed by law is a reason of a permanent decrease of state expenses on research and development. The decrease of state expenditures to this sphere is of a long-term nature. Whereas in 2000 the state expenditures represented 0.60 % of the GDP, a year later it was only 0.59 % of the GDP and this year it is envisaged to be 0.54 % of the GDP on research and development. And pursuant to the National Research and Development Policy of 2000 it was planned to invest 0.70 % of the GDP from the state budget in 2002.<sup>23</sup>

<sup>20</sup>) www.cvca.cz

<sup>21</sup>) H. Rottová: What new happened in fact? in Ekonom 15.2.2001, p. 6, in the section: Supplement to the weekly Ekonom – disputes over a new economy.

<sup>22</sup>) Czech National Bank: Direct Foreign Investments 1999–2000, Statistics Section – Department of Payment Balances, March 2001.

<sup>23</sup>) Resolution of the Government of the Czech Republic No. 16 of January 5, 2000 on the National Research and Development Policy in the Czech Republic.

